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THE INTERNATIONAL SUGAR·JOURNAL

A·TECHNICAL·&·COMMERCIAL PERIODICAL·DEVOTED·ENTIRELY TO·THE·SUGAR·INDUSTRY

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JANUARY, 1960

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1—28

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cane carrier and intermediate carrier

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Mirrlees Slats combine strength with minimum weight.

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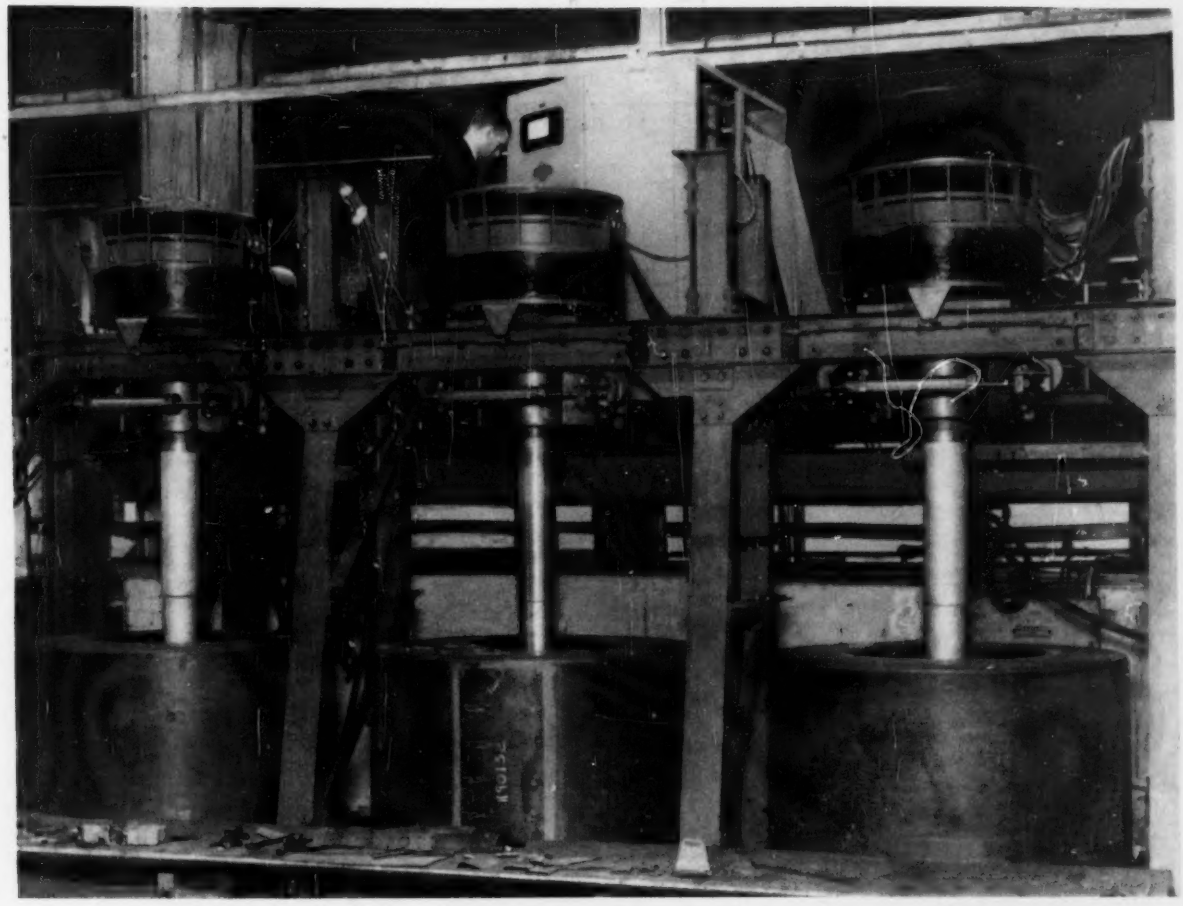

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the first three of sixty 48″ × 30″ 1200 RPM centrifugals for the Taiwan Sugar Corporation, photographed during motor and control gear tests at our works.

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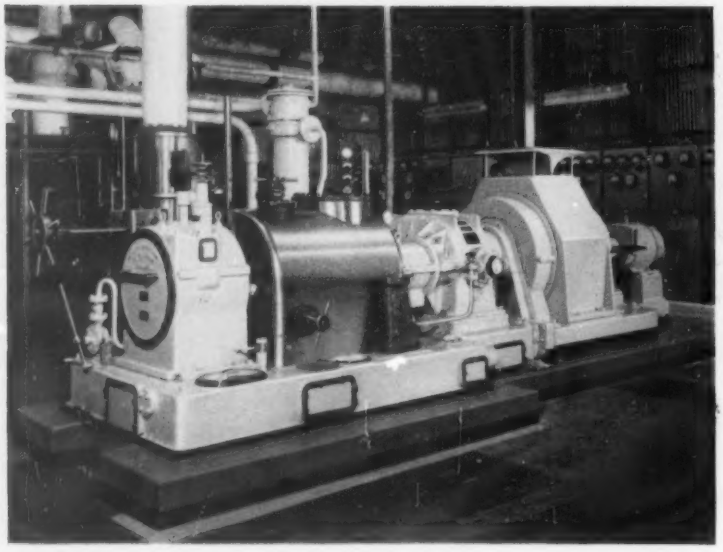

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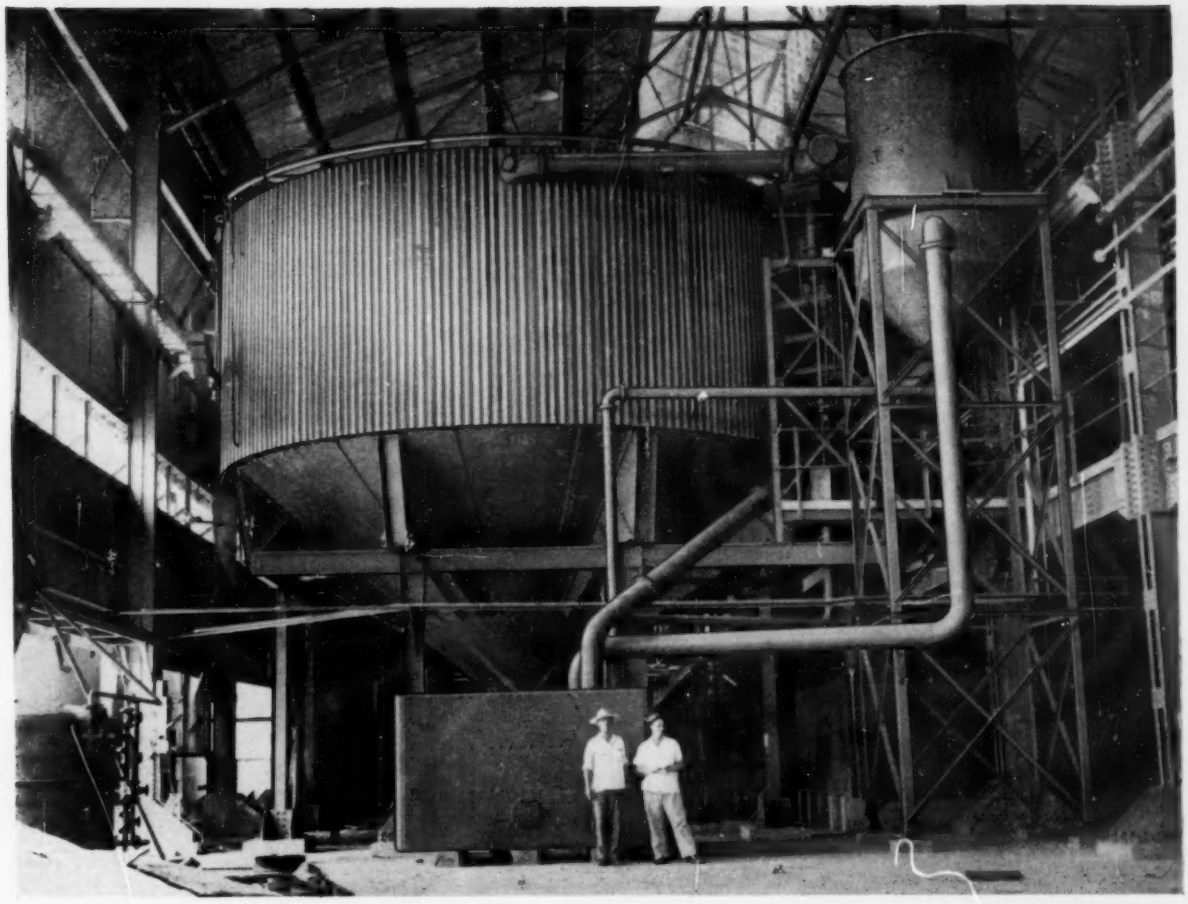

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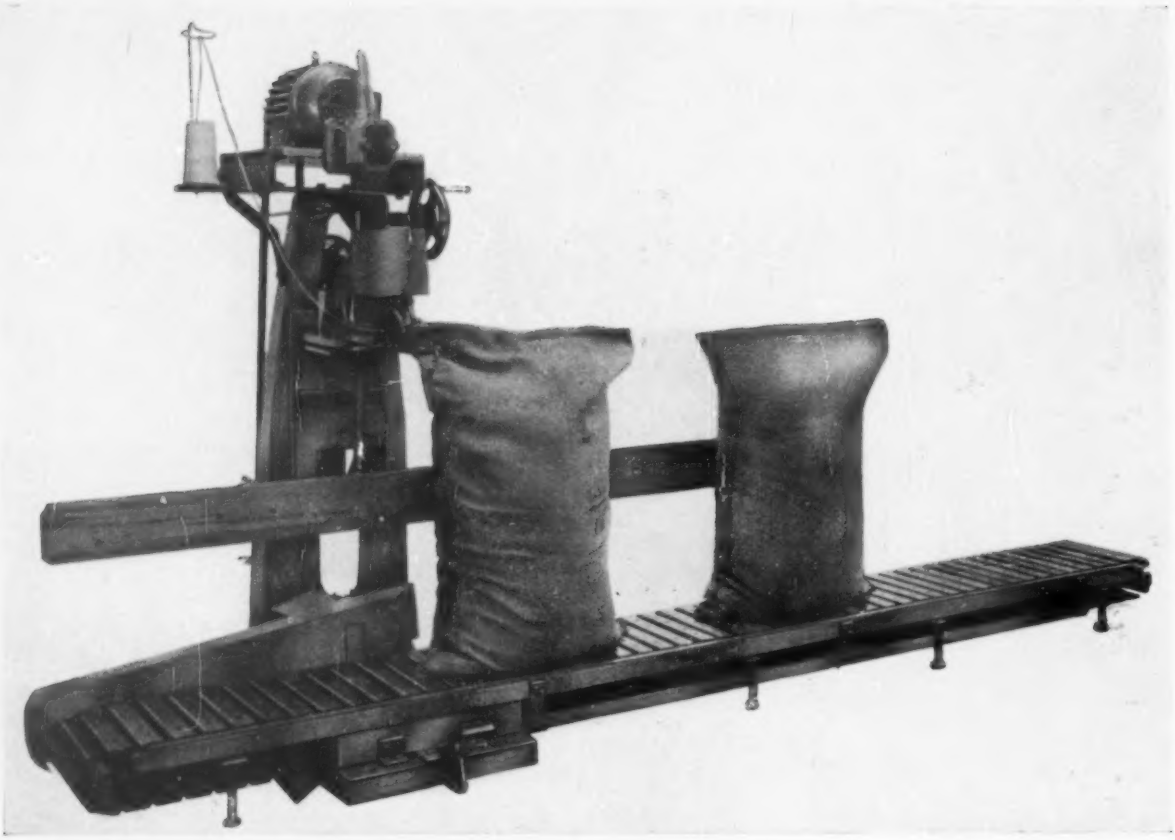

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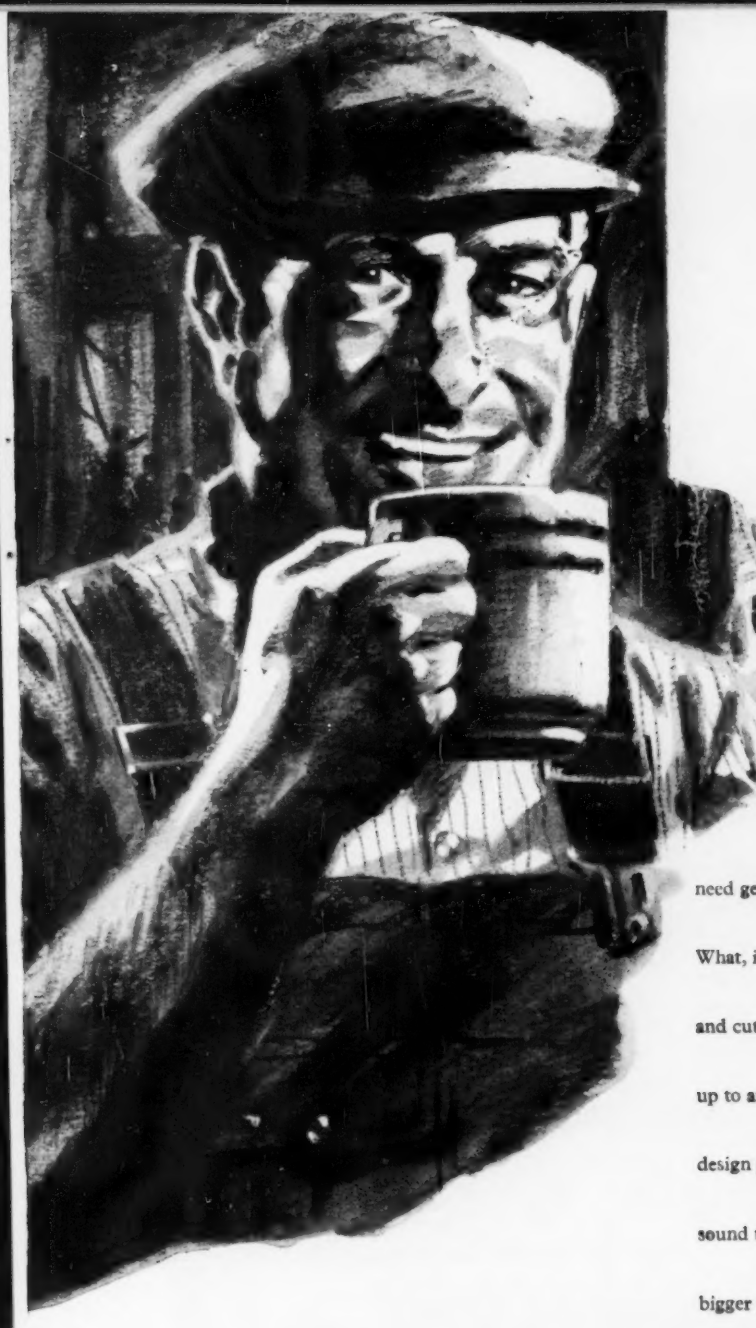

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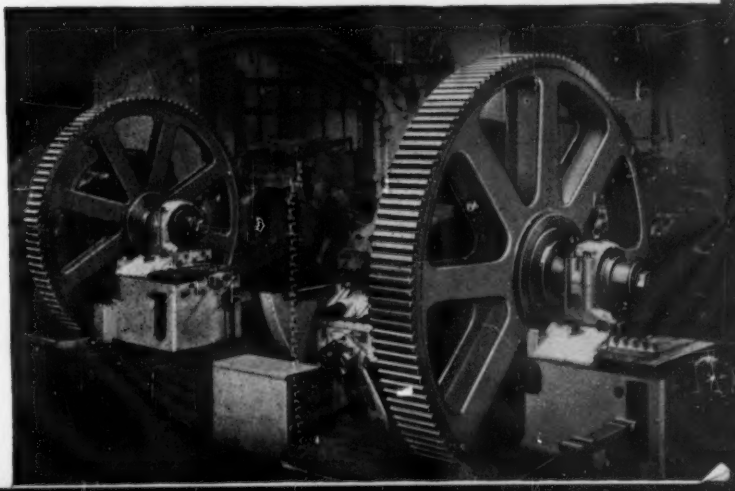

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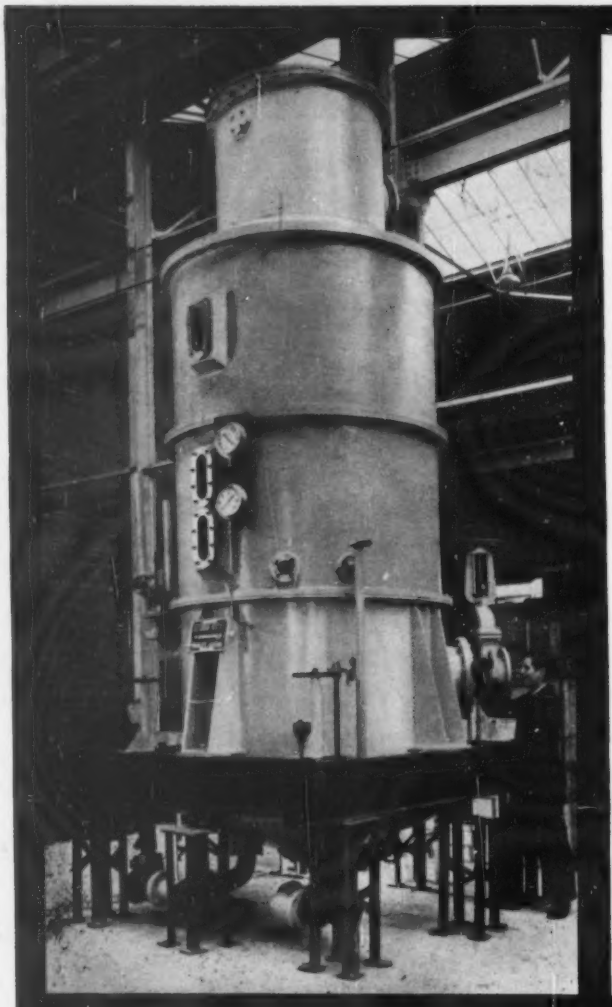

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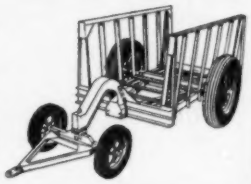
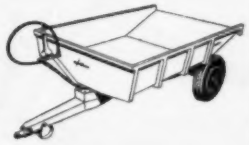


For constructional jobs, road making, etc., this 3-ton hydraulic tipping 'Dumper' trailer is a winner; very strongly made, it will give years of service under the most arduous conditions.



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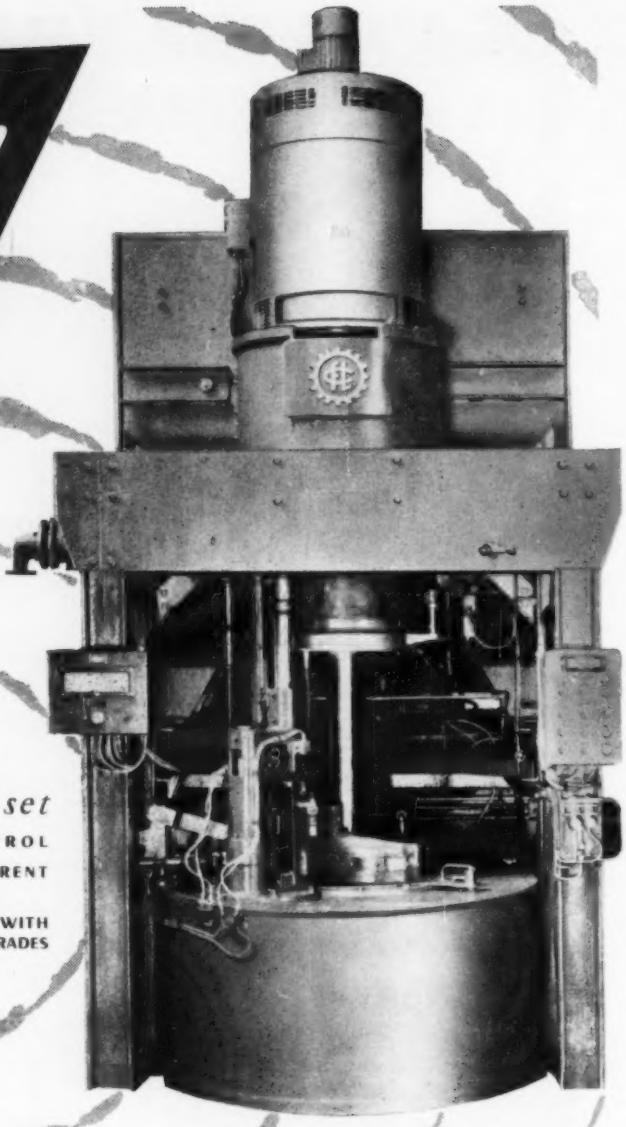

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Battery of 4 centrifugals at the Fontaine-le-Dun Sugar Factory (France)

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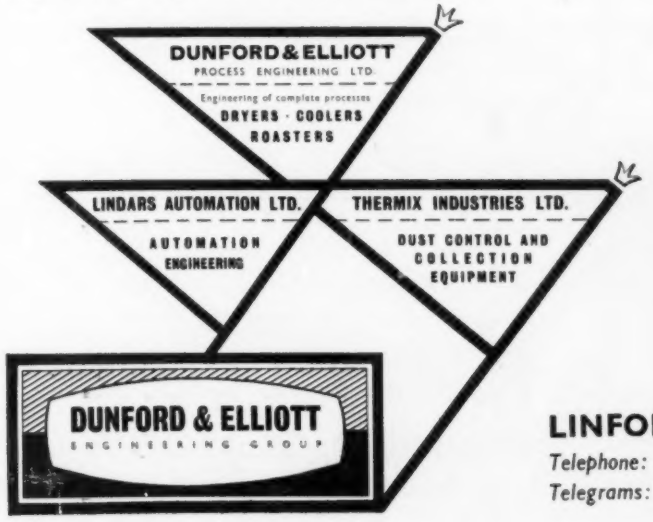

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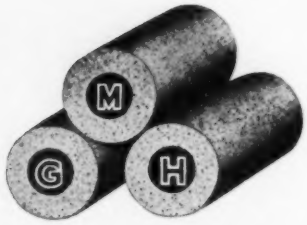
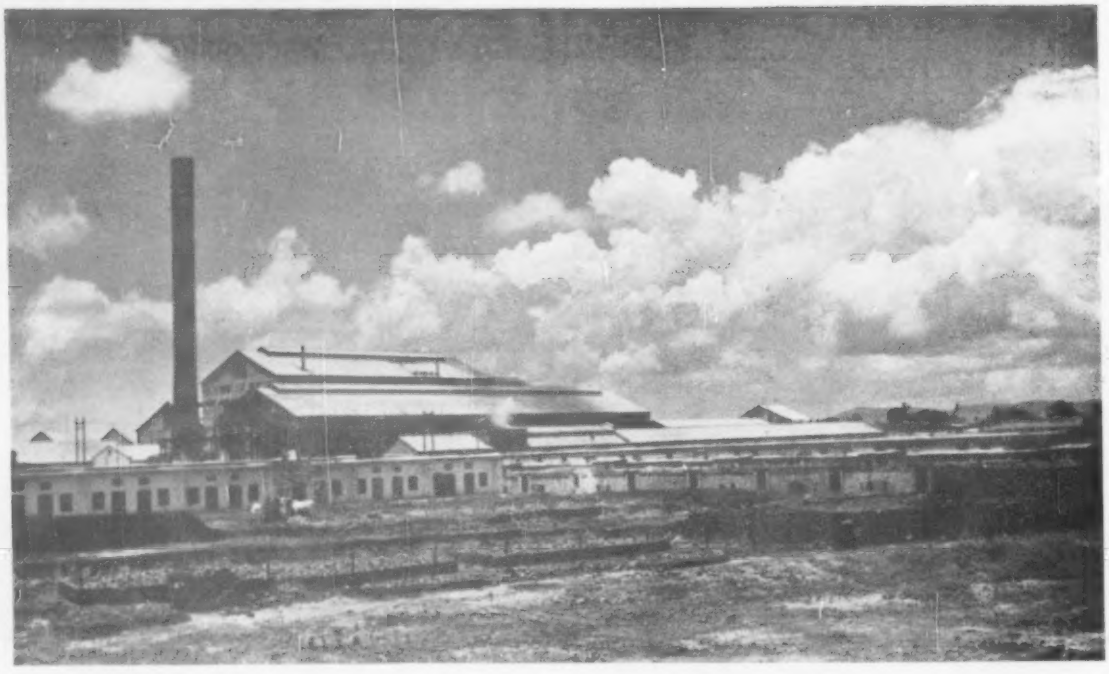
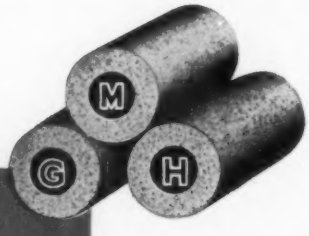




Sugar-Mill Rollers



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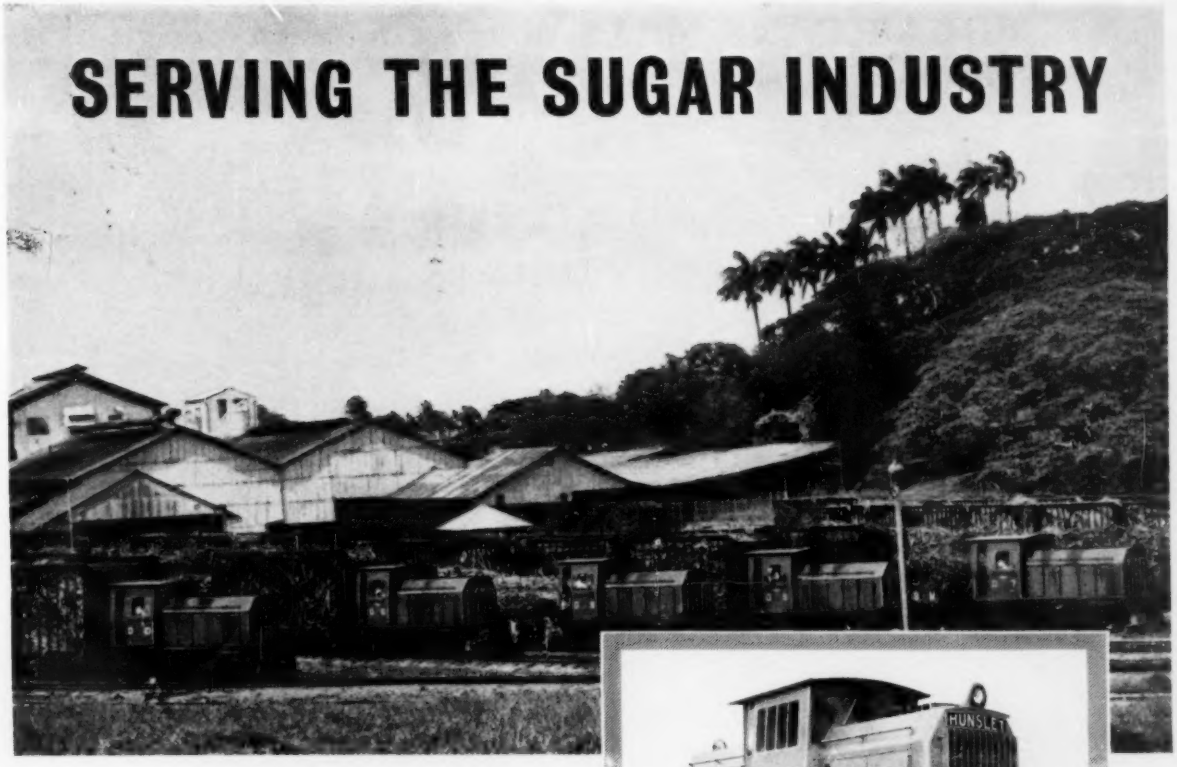
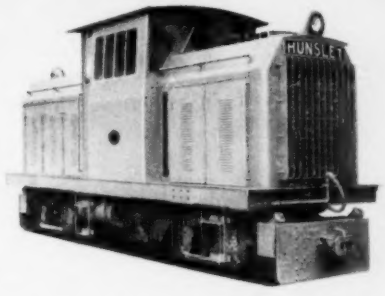


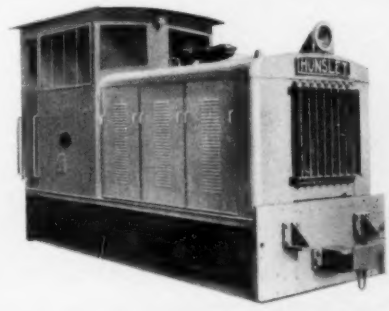
A fleet of Hunslet 204 h.p. 0-6-0 type diesel locomotives on heavy sugar cane haulage duties on a sugar estate in the West Indies.



230 *h.p. 'Articulated' diesel locomotive.*

HUNSLET

101 *h.p. 0-6-0 type diesel locomotive*



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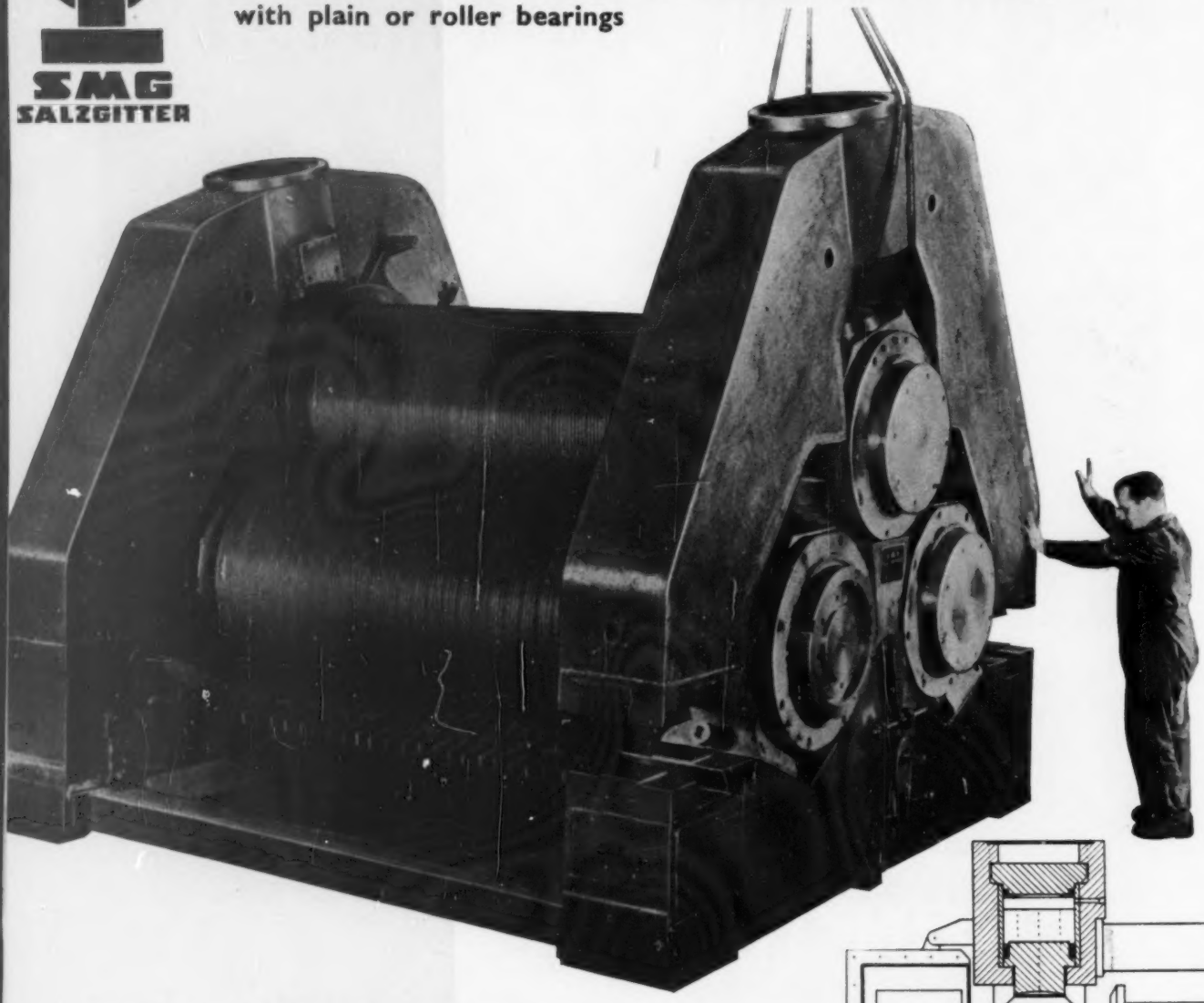

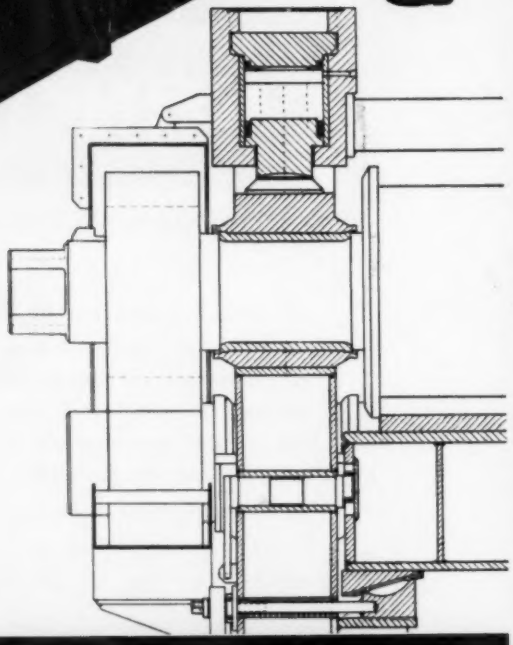

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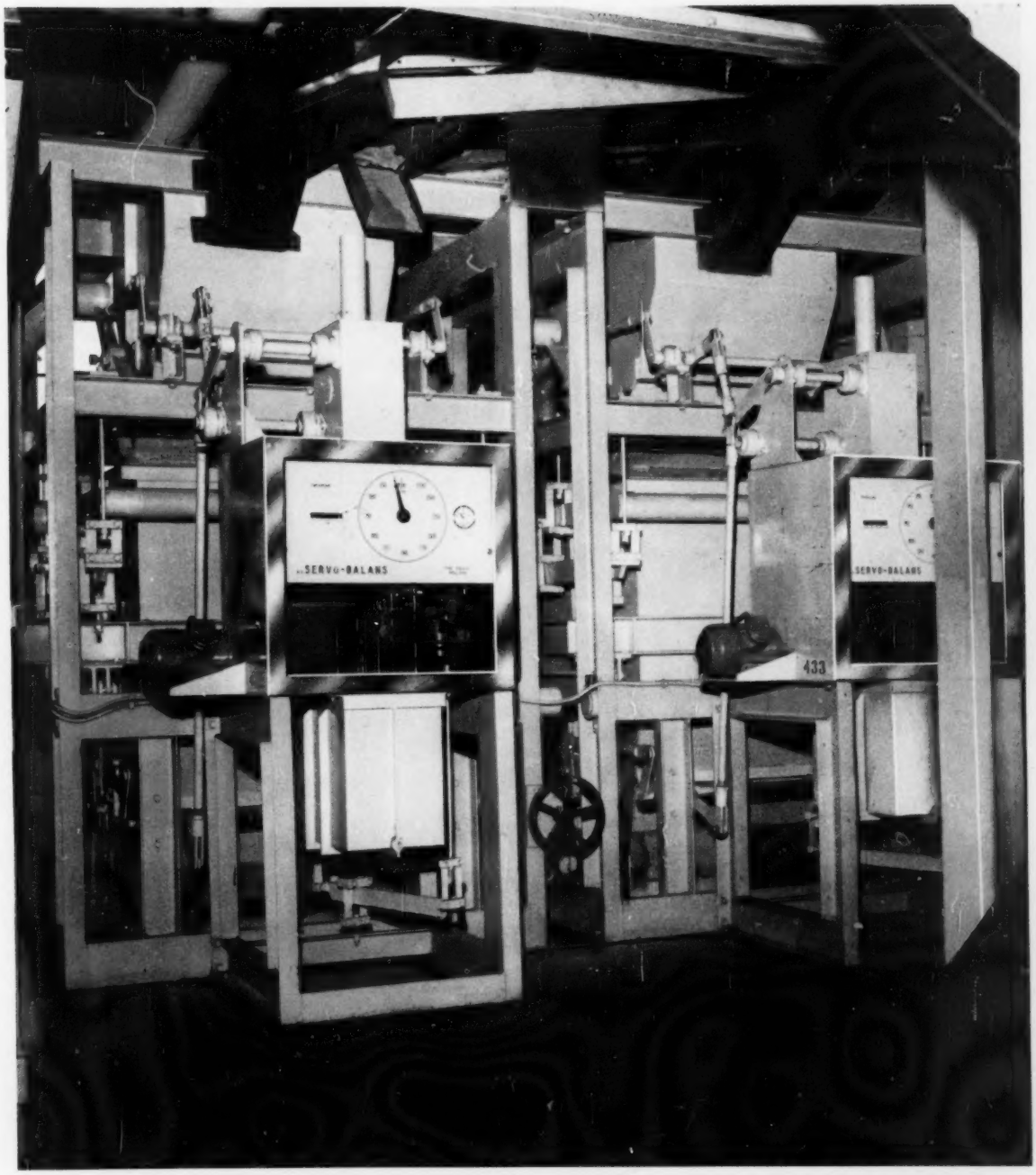

Two 90 t/h raw sugar Duplexweighers installed in South African refinery

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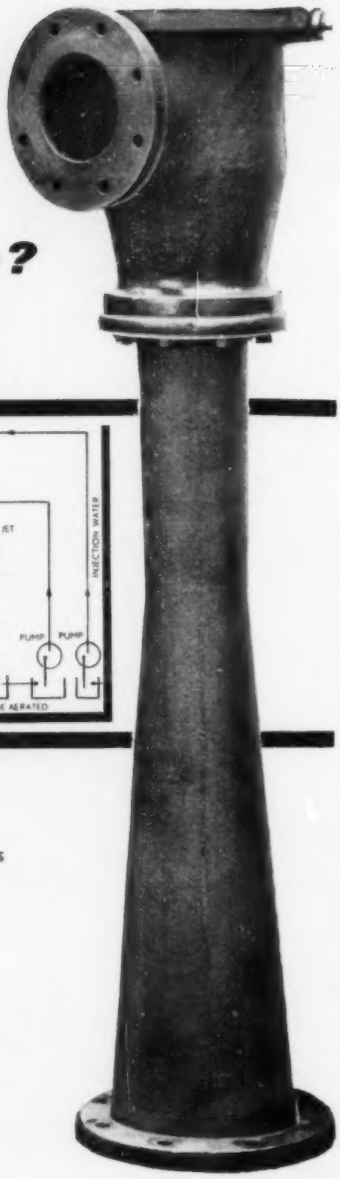
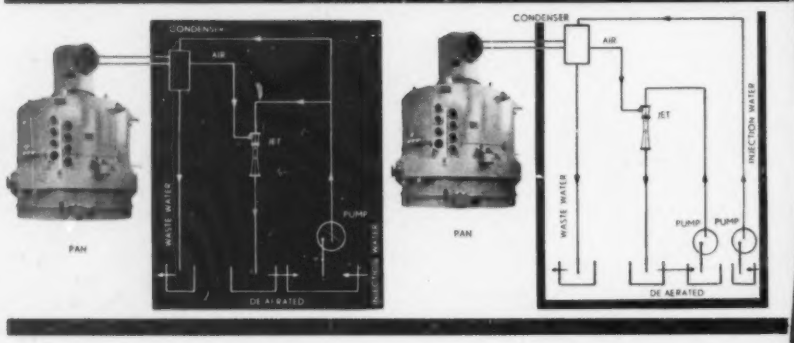
why not fall in line?



SCHEMATICAL ARRANGEMENTS



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4-wheel Model with full locking turntable. As open or closed ends. Also suitable for bananas. In various carrying capacities.

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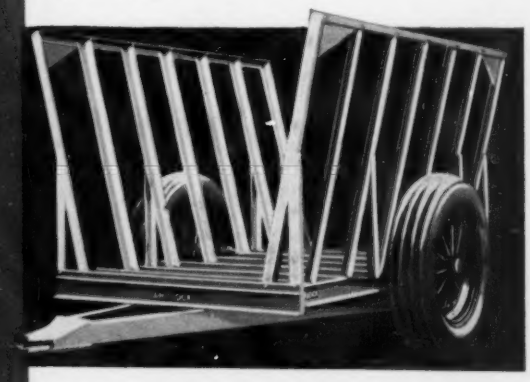
WHITLOCK CANE & FRUIT TRAILERS

4-wheel Goose-Neck type of pressed steel construction with extra heavy bracing for loads up to 6 tons.



A low cost model on large diameter wheels for loads up to 5 tons.

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Whitlock Cane Trailers are backed by many years experience and will stand-up to the job.

Ask for catalogue SC.61 and send details of your requirements.

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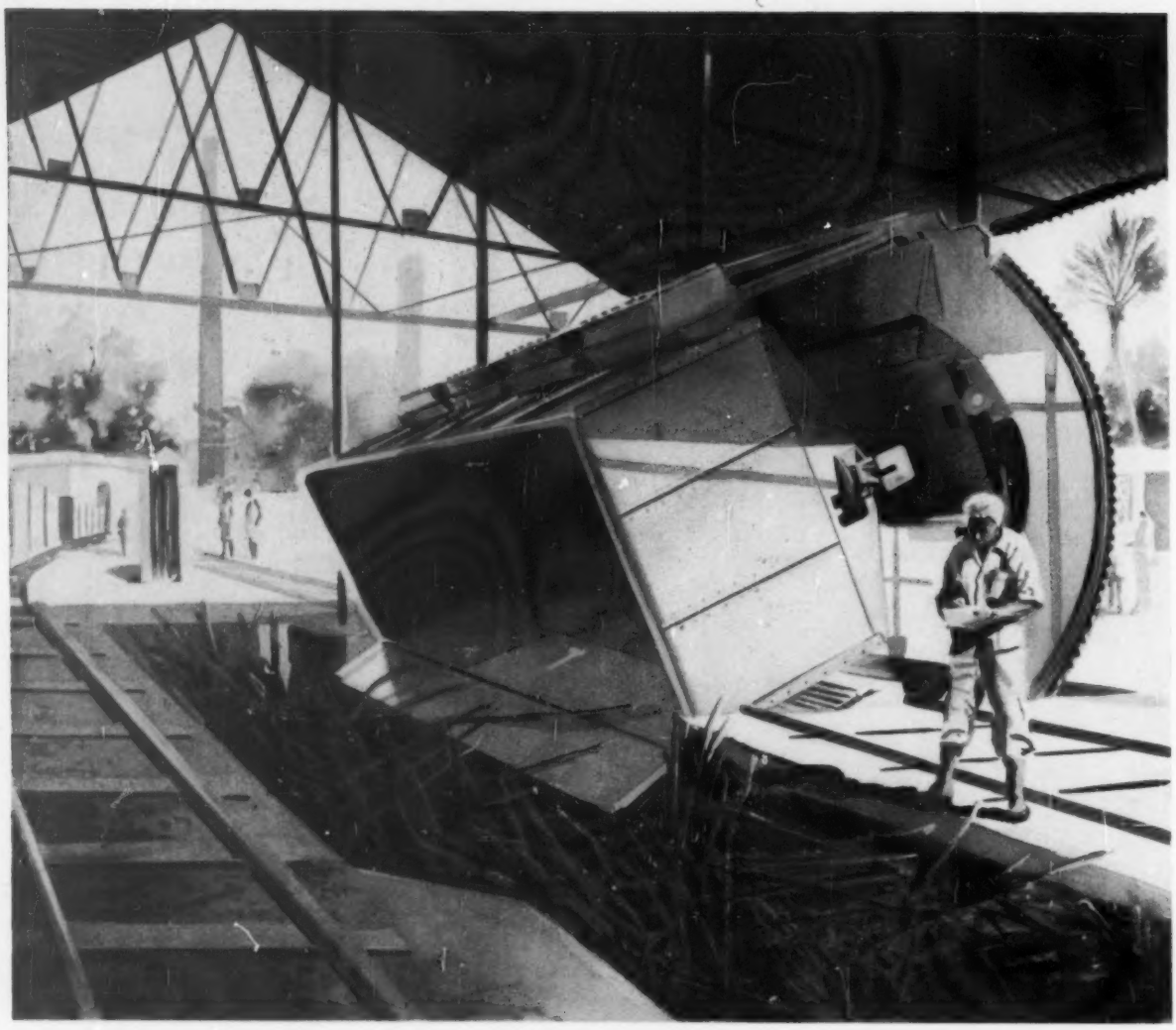

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at Nellikuppam

The Strachan & Henshaw Tippler, installed at the East India Distilleries and Sugar Factories Limited will tip, and unload 4-wheeled and bogie cane cars up to 36 tons gross in two minutes.

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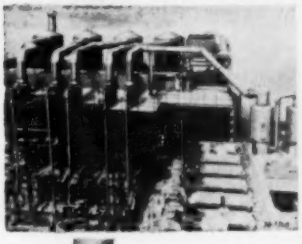

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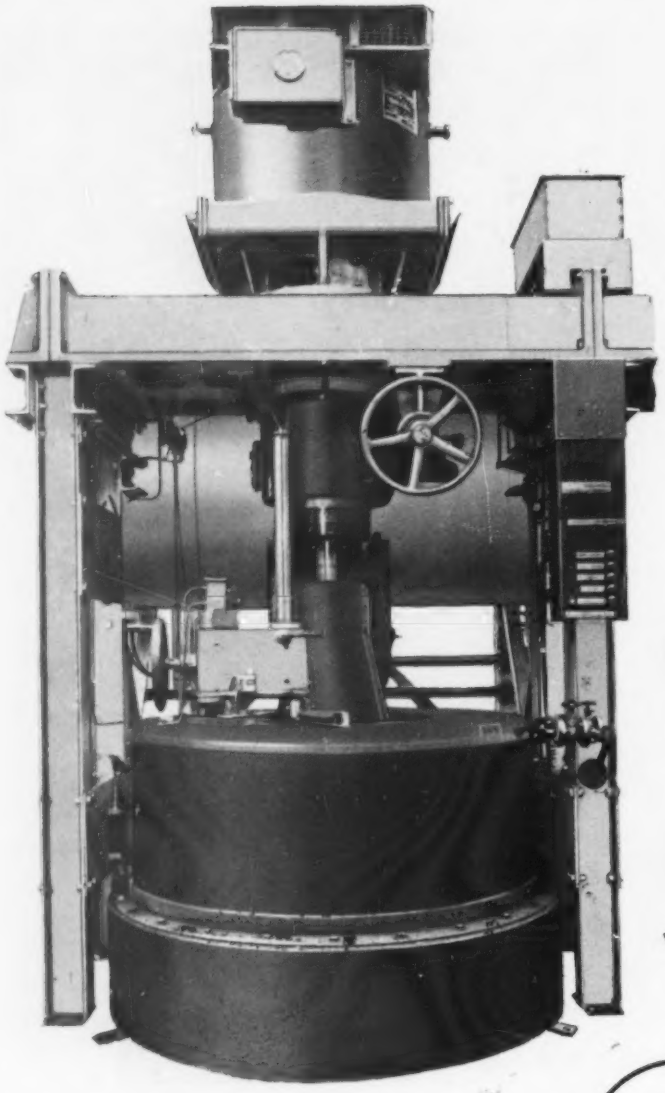

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VOL. 62 *January, 1960* No. 733

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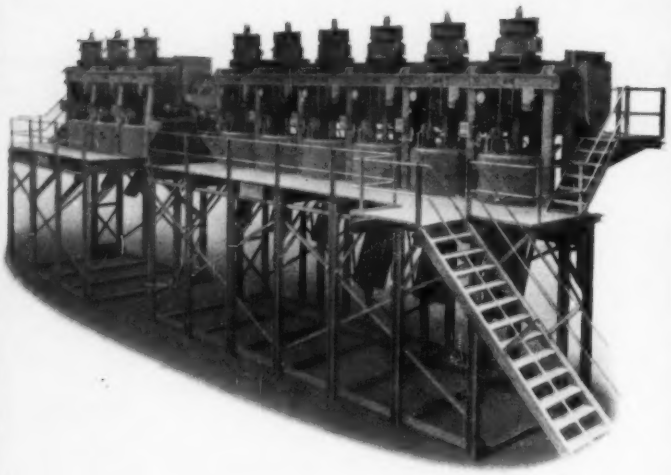

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INTERNATIONAL SUGAR JOURNAL

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NOTES AND COMMENTS

Commonwealth Sugar Agreement.

The Ministry of Agriculture, Fisheries and Food announced on 1st December 1959 that the series of meetings with representatives of Commonwealth sugar exporting territories which began on 1st October had been concluded. Discussions took place on the price to be paid for the 1960 negotiated price bought under the terms of the Commonwealth Sugar Agreement and on other matters arising under the Agreement.

Full Agreement was reached as follows :—

(i) *Price for* 1960.

The price to be paid for 1960 negotiated price sugar will be £44. 8s. 10d. per ton, which is 13s. 2d. per ton less than in 1959.

(ii) *Review of Price fixing arrangements.*

A full review of the working of the price fixing arrangements under Chapter VI of the Agreement has taken place on the basis of up-to-date returns. The system was confirmed and an arrangement made to restrain prices in 1961, 1962 and 1963.

(iii) *Duration of Commonwealth Agreement.*

The Agreement has been extended for a further year and will now run to the end of 1967.

(iv) *Overall Agreement Quotas.*

After a full examination of all the relevant factors in accordance with Article 8(a) of the Agreement it was agreed that the total of overall quotas should remain unchanged at 2,375,000 tons, made up as follows :

	Tons
Australia	600,000
British Honduras	25,000
East Africa	10,000
Fiji	170,000
Mauritius	470,000
South Africa	200,000
The West Indies and British Guiana	900,000
	2,375,000

(v) *Negotiated Price Quotas.*

Under the provisions of Article 15, negotiated price quotas for the year 1960 will be increased by a further 3%.

The rise in negotiated price quotas (i.e. the quantities of sugar bought by the Sugar Board on behalf of H.M. Government at the negotiated price) for 1960 is made under Article 15 of the Commonwealth Sugar Agreement which provides for such increases when United Kingdom consumption of sugar exceeds 2,550,000 tons. In 1959 negotiated price quotas were increased by 2½%. The present increase provides for a total increase over basic negotiated price quotas of 5½%. The effect of these increases is to provide the following negotiated price quotas for 1960 :—

	Tons
Australia	316,500
British Honduras	18,990
East Africa	5,275
Fiji	126,600
Mauritius	353,425
South Africa	158,250
The West Indies and British Guiana	676,308

Quotas for The West Indies and British Guiana include St. Vincent.

(vi) *British Honduras and East Africa.*

The position of British Honduras and East Africa in relation to the Agreement was reviewed. It was agreed that with effect from the 1st January 1960 quotas for British Honduras in Article 2 and Article 13 should be confirmed (see above), and that East Africa should accede to the Agreement on 1st January 1960 with the quotas provided in Articles 2 and 13, as was provided for when the Agreement was negotiated in 1951.

* * *

International Sugar Council.

The Fourth Session of the International Sugar Council was held in Tangier on Thursday, 26th and Friday, 27th November 1959. Mr. BRUCE MARSHALL (Canada), Chairman of the Council, presided over the discussions, which were attended by representatives of thirty countries and by an observer from F.A.O.

The Session which was held in Tangier at the kind invitation of the Moroccan Government was inaugurated by His Excellency H.E.M. DRISS SLAOUI, Under-Secretary of State of Industry and Commerce.

The Council adopted an estimate made by its Statistical Committee, of the minimum net import requirements of the free market for 1960 amounting

to 5,700,000 metric tons raw value (details of the estimate will be published in due course).

In accordance with its August resolution, the Council agreed that Cuba and the Dominican Republic should be entitled to carry forward into 1960 up to 170,000 and 22,000 tons respectively of their 1959 quotas. These amounts will be in addition to the quotas of these countries for 1960 and shall be subject to adjustments under Article 21. Taking into account this decision, basic export tonnages and other permissible exports, as far as they are likely to be utilised, together with the Statistical Committee's estimate of the export possibilities of non-participating countries and the allocation of the hardship quota of 40,000 tons to Taiwan, the Council concluded that total available supplies during 1960 would be of the order of 6,800,000 tons. It decided to fix provisional initial export quotas at 87·5 percent of basic export tonnages, which would reduce supplies by 820,000 tons, thus bringing them into approximate balance with requirements. This allocation is provisional and subject to final confirmation before 1st April 1960, in the light of apparent estimates of requirements and supplies and of the situation prevailing in the sugar market. Should the situation so require the Council would meet early in 1960 to reconsider quotas.

The Council decided to extend to 1st April 1960 the time limit for the deposit of ratification instruments in the case of the few countries which had not yet been able to comply with ratification requirements.

The Council noted progress reports of Committees which considered Multilateral Options and certain aspects of the working of the Agreement. It decided to continue these studies.

The Council unanimously elected H.E. Dr. LEON MARIA GUERRERO, the Philippine Ambassador in London, as Chairman and Mr. KEIICHI MATSUMURA, Japanese Commercial Counsellor in London, as Vice-Chairman for 1960.

The Chairman expressed the Council's appreciation to the Moroccan authorities for their very generous hospitality, for the technical arrangements for the Conference and for the special attention given to all the delegates to the Council.

The Council recorded its gratitute for, and appreciation of, the work of Mr. ERIC ROLL as its Executive Director. Mr. ROLL leaves the Council at the end of the year and will be succeded by Dr. RALPH E. STEDMAN of the Ministry of Agriculture, Fisheries and Food of the United Kingdom.

The next regular Session of the Council will be held in London in March 1960.

* * *

Cuba and the New U:S. Sugar Act.

Despite Cuban protests, a new Sugar Act may contain authority for the U.S. President or Secretary of Agriculture to cut the quota of any foreign country (including Cuba) which treats U.S. nationals unfairly, according to B. W. Dyer & Company, sugar economists and brokers. There is already precedent for a similar clause in a former Sugar Act.

Cuban Minister RAUL CEPERO BONILLA said recently that if and when the U.S. cuts the Cuban sugar quota "such a reduction . . . would be tantamount to economic reprisal or agression. The government of the U.S. has no economic reasons to justify a reduction in our quota because Cuba spends $1.20 in the U.S. for every $1.00 worth of sugar we sell there".

U.S. Congress, convening in January, is scheduled to consider an extension of the present Sugar Act which expires December 31st, 1960. Congress may do nothing until the last possible moment, to see what events develop—particularly in Cuba, where expropriation is scheduled next year to take over "excess lands" from many land-owners, including those of U.S. citizens. While many observers expect a one-year extension of the Act in its present form, there may be some slight modification resulting from a compromise of the sugar industry's ideas.

If Cuba's sugar quota were reduced under a new Sugar Act, the U.S. could replace Cuban Sugar from many sources. For perspective. Cuba produced in 1959 6·6 million tons of sugar, raw value; Cuba's 1959 sugar quota in the U.S. is about 3·2 million tons.

Inasmuch as the U.S. raw sugar price generally is higher (currently about $2.50 per 100 lbs.) than the world raw sugar price, the Dyer Company believes that sellers in the countries listed below would eagerly divert all their surplus sugar to the U.S. if the normal premium continues and U.S. quotas were changed to permit such imports. Of course, if these countries were given sufficient notice, production could be increased substantially in future years.

Based on 1960 estimates of production and local demand, the following selected countries could furnish the U.S. with additional sugar in 1961 at least as follows (in short tons, raw value): Taiwan 870,000; Dominican Republic 700,000; Brazil 400,000; Peru 325,000; the Philippines 140,000, and Mexico 85,000. This total of over 2½ million tons is in addition to the present U.S. quota of 1,227,000 tons from this group.

In addition to the above cane sugar supplies available, another 100,000 tons probably could be obtained from other Central American, South American and Caribbean countries. Moreover, U.S. beet growers could probably provide a substantial amount of additional sugar if given sufficient opportunity.

The Dyer Company concludes that if all Cuban sugar were displaced in the U.S. market, Cuba would be forced to sell her sugar in the world market at a loss currently estimated at about $150,000,000, the premium Cuba receives when selling in the quota-protected U.S. market. This financial loss alone would probably bankrupt Cuba. Moreover, the disruption of normal channels of distribution for disposing of the increased Cuban supplies which would have to be sold in the world market would probably cause further losses. Only at price concessions can new sugar markets generally be captured.

THE BIOLOGICAL CONTROL OF AGRICULTURAL PESTS[1]

THERE comes to mind from the distant past a post-prandial discussion as to the meaning of the expression "natural environment". It arose from a discussion on cholera, at that moment prevalent in the surrounding Districts of India. A leading protagonist claimed that the human body provided the natural environment but the concensus was against him. An environment which was destroyed by the organism in a few hours could never be "natural" through it might properly be termed "optimum". The "natural environment" of any organism is probably best defined as the one in which that organism maintains a relatively constant population. Since, however, most organisms, particularly those dignified by the term "pests", including therein insects, rats and rabbits, have a high, and even prodigious reproductive rate, the natural environment of necessity contains stabilizing factors of control. Complete stability, of course, is never reached, and occasionally the unbalance may be such that certain species may be brought to the verge of extinction. Such was the case when rinderpest swept through Africa in the last years of the nineteenth century leaving its mark in Rhodesia in the necessity for the protection of the eland even till the early twenties. Locust plagues, throughout the ages, and, in recent years, myxomatosis afford other examples.

There are two interesting aspects of this natural phenomenon. The first is that rarely, if ever, is a species completely eliminated except when the pest is man; for, regarded impersonally, man is the biggest pest of all. Nature, left to herself, in the end achieves a stabilized position in the organism-environment relationship. The second point is that even if two species have the same reproduction rate, one may be a dangerous pest and the other rare. The difference lies in the fact that the controlling factors of the environment are more effective in the one case than in the other.

Into this natural stable environment man has entered as a disturbing influence. His agricultural practices, involving clearance of natural growth and wide expanses covered by a single species (monoculture) for lengthy periods, have created, often abruptly, an entirely new environment to which the various organisms have to adapt themselves. Since such expanses rarely occur in nature they may be considered unnatural; they usually provide conditions in which nature, if left to herself, would eliminate the crop. Man has, in fact, created an artefact which would seem to eliminate hope of establishing a natural balance; pests (and disease) would appear to be the inevitable concomitant of agricultural practice. It may very well be that an increase in the attack by pests will follow as each "advance" in agricultural technique introduces further artificiality into the environment.

That pests (and diseases) are on the increase few will deny and remedies have been sought in two main directions. On the one hand the search for control is made through treatments lethal to the pest, generally termed chemical control, which are, in fact, further advances in agricultural technique—it is the direct approach. On the other, it is made indirectly through what has come to be termed biological control, that is, through a restoration of a natural pest-parasite relationship—a reverse process to the former. Biological control has had many notable successes not the least striking of which was the introduction from Australia to California in 1889 by Koebele of the lady-bird, *Vedalia* (*Rodolia*) *cardinalis*, to control the cottony cushion scale (*Icerya purchasi*) itself accidentally introduced on citrus, also imported from Australia. The sugar cane, particularly in Hawaii, provides several notable examples In 1903, there was an outbreak of leaf-hoppers (*Cicadulina*) sufficiently serious to close down one plantation and threaten the whole industry. The pest was soon brought under control by the introduction of the egg parasite *Paranagrus optabilis* (1904) from Australia, *Ootetrastichus beatus* (1916) from Formosa and finally the egg-eating bug *Cyrtorhinus mundulus* (1920) again from Australia[2]. Similarly the chafer beetle *Anomala orientalis* has been brought under control by the wasp *Scolia manilae* from the Philippines (1916) and the beetle-borer *Rhabdocnemis obscura*, itself an introduction to Hawaii, by the Tachinid fly *Microceromasia sphenophori* (1910).

Hawaii has an unique experience in successful biological control in that there exists now no serious pest of sugar cane. This satisfactory condition is largely due to the enterprise of the Hawaiian Sugar Planters' Association in organizing scientific work in 1895. But that other factors are at work is indicated by West Indian experience where, latterly, much attention has been given to biological control of the cane borers, in particular *Diatraea saccharalis*, *Diatraea canella* and *Diatraea impersonatella*. Here the position is more complicated owing to the very divergent ecological conditions of the various territories, with different species dominating in each. There are several indigenous parasites of the borer, of which *Paratheresia claripalpis* is the most important in Trinidad and, in Barbados and some other territories, *Trichogramma minutum*; and several introductions have been made, notably *Lixophaga diatraeae* from Puerto Rico and Cuba, and the Amazon fly, *Metagonistylum minense* from Brazil. The reactions in the different territories are too divergent to be detailed here but, of especial interest, is the experience in Barbados, recounted by J. R. METCALFE[3]. While

[1] G. C. VARLEY, Fernhurst Lecture, *J. Roy. Soc. Arts*, 1959, **107**, 475–490.
[2] *I.S.J.*, 1928, **30**, 528.
[3] *Trop. Agric.*, 1959, **36**, 199–210. *I.S.J.*, 1960, **62**, 5.

repeated unsuccessful efforts were made to establish exotic parasites of the borer, massive releases amounting to 300 m per annum have been made in recent years of the indigenous *T. minutum*. The joint infestation was thereby reduced from 33·5% to 13·5% but still leaving the borer the chief island pest with an annual loss of some 5,000 to 10,000 tons sugar. The interesting point, however, is that its status appears to have altered and a position has now been reached where a natural Spring multiplication provides all the protection possible. The numerical borer-parasite relationship is no longer the limiting factor; instead, it is the ability of the parasite to find adequate hosts.

In the above instances, and in general, the problem of control has in each case been treated as an "ad hoc" one and little attention has been given to the basic factors influencing the host-parasite relationship. In many instances, of course, as in that of the cane leaf-hopper of Hawaii, the position is simple—the accidental introduction of a pest without the parasite which controls its numbers in the country of origin. The Barbadian example, confined to an indigenous species, offers a more complex problem and introduces not only the question of the numerical balance between host and parasite but a seasonal factor. Not the least important factor in this wider field appears to be the synchronization of the cycles of host and parasite. It would seem that, if the maximum benefit is to be obtained from biological control, there is needed something more than the treatment of each outbreak as an "ad hoc" problem. An answer is required to the question: are there any broad underlying principles to be traced in this host-environment relationship which could be put to practical use?

It is in the discussion of these more fundamental issues that the major interest of the lecture by G. C. VARLEY, Hope Professor of Entomology, Oxford, lies. There has been built up in the last thirty years a considerable but scattered literature and much of the data given above is drawn from this paper. The study passes into a mathematical stage; unfortunately, too, the terminology has become confused[5] and it is possible to give only the merest outline. The central idea is one of density-dependent factors. That idea would seem to embrace such factors as food supply, crowding and so on. Parasitism appears to fall under a different head owing to the interaction between two organisms and it may be that the reproductive rate of the parasite is influenced by host density. The numerical increase of the host is followed by a delayed increase of the parasite which continues after the peak incidence of the host. With a similar lag, the decreasing incidence of the host is followed by a decrease in the parasite. The host-parasite relationship, thus, falls into four periods, to alternate ones of which the density-dependent principle applies; in the others a reverse principle, resulting in a correlation between the host density and % parasitism which becomes approximately zero for the entire period.

The two theories directly covering the more fundamental issues of host-parasite relationship discussed in the lecture are those of W. R. THOMPSON[6] and A. J. NICHOLSON[7]. Any detailed statement of these theories here would be out of place, but the need for that deeper study, for which the lecturer pleads, is well shown by a consideration of the divergent procedures in the choice which the adoption of one or the other theory would dictate. Thus, if W. R. THOMPSON is right, the parasite with the greatest egg laying capacity is the one to employ, and the more species that can be introduced the better. On the other hand, if A. J. NICHOLSON is right, the absolute egg capacity of the parasite is of minor importance and the critical factor is its capacity to find hosts at low density; further, it will be best to introduce only the most efficient parasite, for the introduction and establishment of further species can only increase the average population density of the host. Until theories pointing to such divergent procedural practices are harmonized, biological control must continue to be largely a hit-or-miss affair.

Biological control may appear to be at a disadvantage when compared with chemical control, in that it is a question of a gradual build-up as opposed to an immediate favourable effect. Greater success appears to have been obtained in the case of crops occupying the ground throughout the year, of which sugar cane may be accounted one. But it has one advantage: nature can take a hand in the gradual evolution—more efficient parasites to counter the more efficient pest—thus maintaining a long-term balance. That balance can never be attained by chemical control; of the speedy evolution of strains resistant to insecticides there are already too many instances.

H. M.-L.

Implement for turning under of green-manure crops. P. C. STONE. *Taiwan Sugar*, 1959, **6**, (3), 21–23.—The implement described and illustrated is a standard disc plough to which is added a spring-actioned presser. This ensures that heavy growths, such as *Crotalaria* or *Sesbania*, are pressed close to the ground and do not get entangled with the discs.

* * *

Insect resistance in Coimbatore canes. R.A.AGARWAL. *Indian Sugar*, 1959, **8**, 785–796.—The article gives a useful review of the various pests to which the Co varieties are heir, not only in India but wherever they are grown. The first section records the structural peculiarities of the several varieties as affecting their response to the several pests; a second section lists the recorded observations under the varietal Co number. The different varietal response to a particular pest under the wide range of conditions, it is noted, renders the problem of breeding for resistance extremely complex.

[5] *Nature*, 1958, **181**, 1778–1781.
[6] *Ann. Rev. Ent.*, 1956, **1**, 379–402.
[7] *J. Animal Ecol.*, 1933, **21**, 132–178.

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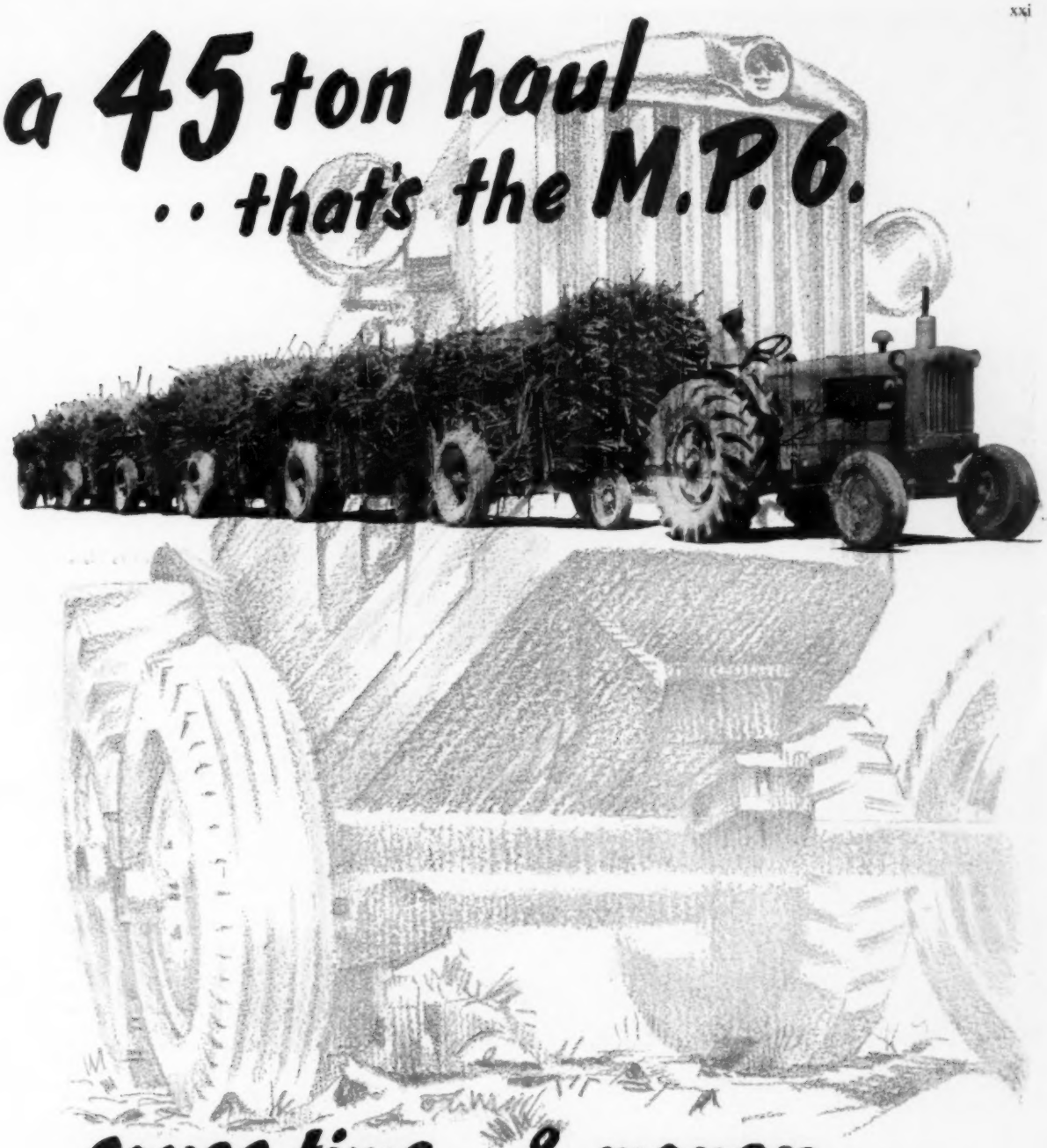

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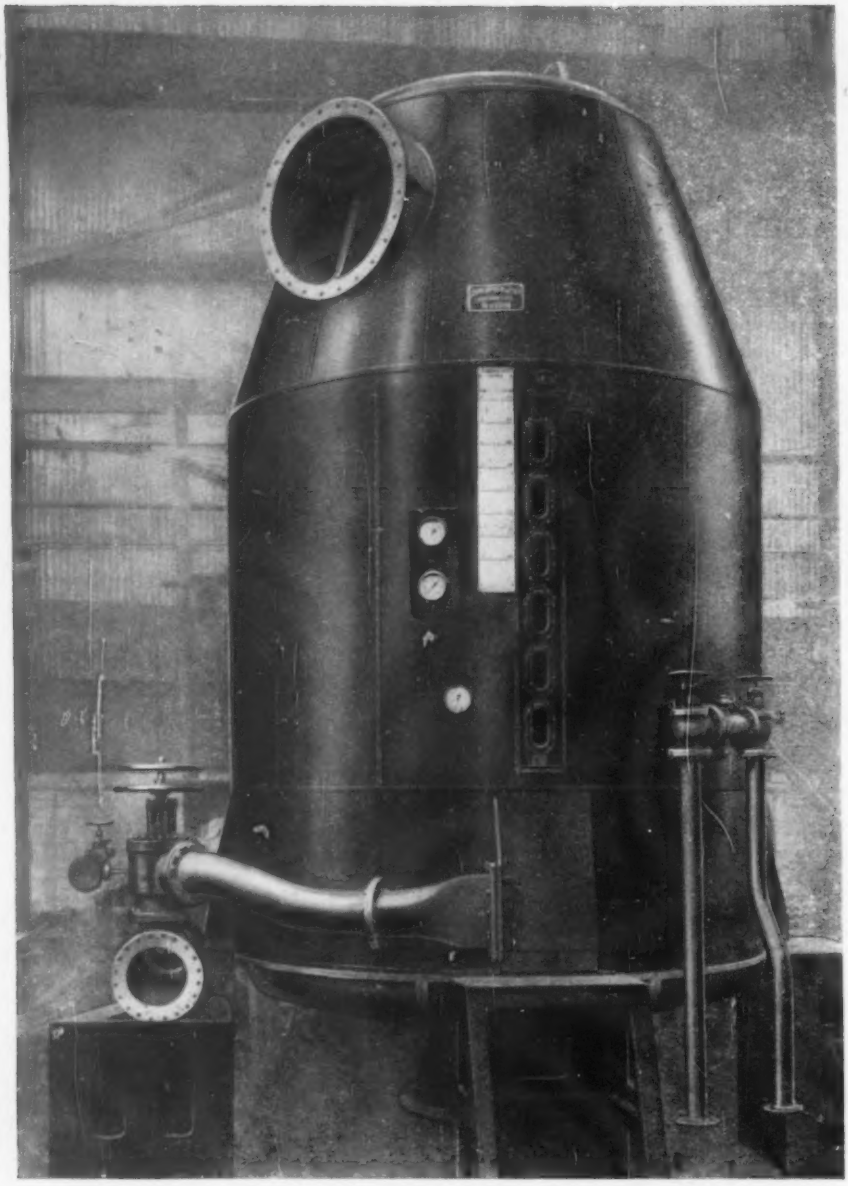

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SOUTH AFRICAN SUGAR EXPERIMENT STATION REPORT, 1958/59[1]

DURING the year Dr. A. McMARTIN retired for health reasons and was succeeded as Director by Mr. J. WILSON, who assumed duty in April, 1959.

The main projects in the programme of research and investigations were continued and expanded according to plan during the course of the year. A number of new projects, including experiments on the induction of flowering for breeding purposes and preliminary investigations on problems of soil microbiology were commenced and have already yielded encouraging results.

In the plant breeding section, 144 crosses were made, which will permit the raising of about 40,000 seedlings for progeny selection purposes during 1959.

Some 40,000 seedlings from the 1957-58 crosses were transplanted to the field, approximately 10 per cent of these being established at Chaka's Kraal Experimental Farm under irrigation.

Further distributions of the varieties N:Co 382 and N:Co 334 were made during the year, while bulk propagation of the variety N 50-211 was undertaken preparatory to making application for its release in 1959.

Flowering was induced in varieties known to flower only sporadically under the natural conditions prevailing in Natal by exposing shoots over prolonged periods to 12½-hour daylengths. This technique should prove to be of great practical value in breeding work.

Further studies on eelworm distribution have indicated that in Recent Sands in particular, eelworm populations may often be sufficiently large to cause appreciable reductions in crop yields. Investigations on this pest are being continued in conjunction with studies on soil microbiology. While ratoon stunting disease studies received priority in the investigations of the Plant Pathology section, studies on other diseases of note, such as gumming disease, red rot disease, mosaic, smut and chlorotic streak were continued and expanded as the situation warranted.

The results from a comprehensive series of past and existing fertiliser trials have now built up a useful picture of crop responses to fertilizer applications over a wide range of soils and localities. These results taken in conjunction with soil and leaf analytical data will form the basis for firm and realistic recommendations for fertilizer applications throughout the Industry in the future.

Investigations have now been extended to throw light on variety-fertilizer interactions, with the laying down of a variety-fertilizer trial.

Preliminary studies on trace elements were commenced in both soils and cane leaves and striking differences between soil groups were early apparent.

An attempt at providing a soil sampling service, with native samplers under European supervision, was discontinued after three months, when it became apparent that costs were out of all proportion to the number of samples collected.

Soil survey work in connection with the mapping of soil groups in Zululand revealed the presence of two hitherto unrecorded soil groups, viz. soils respectively derived from cave sandstone and from Beaufort beds. The latter, which was found fairly extensively, has several peculiarities. Chief among these is the frequent presence of extremely alkaline sub-soils rendering them liable to brak with the indiscriminate use of irrigation.

The preparation of estate maps showing soil group distributions in colour and the acreages under cane in each was continued.

AGRICULTURAL ABSTRACTS

A preliminary reassessment of *Diatraea saccharalis* (F.) in Barbados. J. R. METCALFE. *Tropical Agric.*, 1959, **36**, 199–210.—In 1929, mass rearing of *Trichogramma minutum* was commenced and, in recent years, some 300 million or more have been distributed annually. The effect of this work is assessed here, periodic attempts to introduce *Lixophaga diatraeae*, *Metagonistylum minense*, *Ipobracon grenadensis* and *Agathis stigmaterus* having all failed. In spite of this massive release over the years, the borer still remains the chief pest of the sugar cane and is estimated to cause a loss of 5,000 to 10,000 tons sugar annually, though the control at first obtained, with a joint infestation reduced from 33·5% to 13·5%, appeared promising. A detailed survey, carried out in 1958, is recorded here. This indicates that the *Trichogramma* status has entirely altered since liberation; natural multiplication in the spring is such that releases form an insignificant addition to their numbers and a position has been reached where control is limited by the ability of the parasite to find a sufficiency of hosts.

* * *

The hot-air oven can control ratoon stunting disease. R. J. STEIB and S. J. P. CHILTON. *Sugar J.* (La.), 1959, **22**, (12), 19, 20.—An account is given of an electric hot-air oven[2], now in commercial production, for treatment of cane setts. The design was worked out following the experimental evidence obtained at Houma indicating that a lower mortality occurred with hot air than with hot water treatment.

[1] *S. African Sugar J.*, 1959, **43**, 695-697.
[2] See *I.S.J.*, 1957, **59**, 353.

THE SUGAR CANE IN THE PHILIPPINES

Proceedings of the 4th and 5th Conventions of the Philippines Sugar Technologists.

TWO papers delivered at the 5th Convention in 1957 by C. L. LOCSIN and C. ALINCASTRE respectively, deal with the major problem facing the industry, aptly termed by the latter "The Big Q in the Philippine Sugar Industry". The Laurel-Langley Agreement of 1955 imposed a progressive duty on Philippine sugar entering the United States rising from 0·07 pesos per picul (5%) in 1956 to 1·40 pesos (100%) in January 6—July 1974. It is under the shadow of this Agreement and the pressing need to reduce costs of production, both in the factory or field, that the investigations described in the various papers have been undertaken. In this review, the year in which the paper was presented follows the name of the author.

Cultivation

The complex variety x fertilizer trial conducted in the two preceding years is reported by C. L. LOCSIN and F. T. TABAYOYONG ('56) in great detail, and by the latter author ('57). The major conclusions refer to the varieties. To the report a note is added indicating Co 440 and Co 449, not included in the trial, to be promising varieties. In the latter paper, the interaction between amount of fertilizer and its cost in determining the economic dressing is indicated. The use of filter cake as fertilizer is described by F. A. PINEDA ('56) and by A. A. AARON and V. C. CALMA ('57). In both cases increased yields both of cane and sugar were obtained, but the former adds an economic valuation on the basis of 3 pesos/ton delivered on the field. Trash mulching, in which the trash is piled on alternate rows and the bare row off-barred, is compared with trash burning by F. A. PINEDA ('56) and, on the average of two seasons, yielded increases of 10·7% cane and 27·5% sugar. Added to this is a reduced cost of tillage, since only alternate rows are cultivated. The present position with regard to chemical weed control is the subject of a paper by I. P. FERRARIS and M. V. LACSON ('57), and the losses due to insect attack are reviewed by V. L. SAPLALA ('57).

Foliar diagnosis, as a cultural aid, is discussed by M. T. ILAGA ('57). Sett treatment with "Aretan", according to experiments by J. T. TAPAY and F. E. MERCADO ('57), indicated that the maximum strength used, 45 g/gallon water, was below the optimum concentration. For the determination of organic matter in soils, four methods, based on U.S.D.A. Circular No. 757, are compared by J. K. DEMETERIO *et al.* ('57). The Pampanga Sugar Development Co. has a dust arrester at the top of the chimney from which the dust is removed by a hot-water spray and then passes to a series of lagoons with successive diminishing temperatures from 50°C. The use of the first two lagoons for treating cane points is described by F. A. PINEDA ('57). Lastly, A. GORDON ('56) details preliminary studies of a system for determining the "effective rainfall", based on assumed values for effective soil capacity and daily evapo-transpiration from fields from which both water requirements and crop predictions could be determined. The term "effective rainfall" is, perhaps, an unfortunate selection, for it was applied many years ago to a different measure of rainfall on which similar predictions could be based[1], and it may even have been adopted earlier.

Varieties

As noted above, varietal evaluation formed part of a variety-fertilizer trial. Additionally, J. T. TAPAY ('57) records the result of a statistically based trial (plant and first ratoon) of 8 Philippine selections of the 48 and 49 series. All were less susceptible to Fiji disease than Alunan, the standard, and, mainly in consequence, 3 varieties, Phil 49-22, Phil 48-15 and Phil 49-4, are particularly promising. The same author describes the flowering characteristics of numerous varieties in relation to time and intensity of arrowing and, in particular, the amount and viability of the pollen. A brief review of the work on breeding sugar cane since the war at the Central Experiment Station, College of Agriculture, Laguna, is given by V. C. CALMA *et al.* ('56).

Administration

In most industries, administration offers a wide field for effecting economies and, in the cane sugar industry, opportunities occur both in field and factory. In the case of the former, the rôle of railroad transportation is discussed by M. MENDEZ. ('56). In dealing with labour management, H. R. ROSALES points out the importance of team work. The major trouble is the seasonal nature of the work but, as a measure of accomplishment, he points out that, while the price of sugar has risen only two-fold since before the war and that of materials four-fold, labour receives more than four-fold. Lastly, that very difficult problem, the relationship between landlord and tenant, is the subject of a paper by J. TIGLAO *et al.* ('56). An analysis is given here, field operation by operation, of the charges as equitably divided between the two.

H. M.-L.

Greek Second Sugar Factory[2].—The Polish Government has offered the guarantees requested by the Greek Government for the erection of a second sugar factory and it is therefore thought to be certain that Greece will buy the second sugar factory in Poland, supplying in exchange tobacco to the value of about $3,000,000.

* * *

Sugar Factories for Vietnam[3].—A press agency report from Saigon states that four new sugar plants are to be set up. These together with the two existing factories are expected to raise the domestic output of granulated sugar to 72,000 tons —some 5000 tons short of current consumption.

[1] *I.S.J.*, 1934, **36**, 151.
[2] F. O. LICHT, *International Sugar Report*, 1959, **91**, (Supp. 21), 285.
[3] C. Czarnikow Ltd., *Sugar Review*, 1959, (431), 188.

Transition: effectiveness and implications of breeding sugar cane in an indoor environment at Canal Point, Louisiana. P. H. DUNCKELMAN. *Sugar Bull.*, 1959, **37**, 229–252.—In an earlier paper[1] the author and his associates, in describing the breeding programme at Canal Point, noted modifications in technique recently introduced. The major obstacle here is the weather, in particular the low night temperatures. The present paper records the history of the transition, now completed, from outdoor to indoor breeding, gives a long list of crosses made in 1958 and outlines the objectives of the programme.

* * *

Effect of depth of placement of seed piece and date of planting on yields of cane and sugar from CP 36-105 and CP 44-101. L. P. HEBERT and R. J. MATHERNE. *Sugar Bull.*, 1959, **37**, 260–265.—These experiments, conducted at Houma, Louisiana, are concerned primarily with the growing tendency to early planting; a tendency, resulting from the greater resistance to cold exhibited by the newer varieties, to plant in August instead of October. Yield of both cane and sugar were little affected by date of planting but, at the earlier date and especially on lighter soils, planting at a greater depth (10 in) proved desirable. The advantages of summer planting, among them lower cost, have to be set against the disadvantages: owing to the shorter length of stalk, a larger area has to be cut for seed cane.

* * *

The buffering capacities of soils in the Victorias milling district (Philippines). ANON. *Victorias Milling Co. Release*, 1959, (23), 11pp.—Some 99% of the soils of the area have pH values below 6·0 and the average has decreased from 4·9 to 4·6, which is nearer the critical level for sugar cane growth. A study of the buffer capacities of 11 major soil types, covering 70% of the cane area, are recorded. The sharpest increases in pH from dressings of lime occur between pH 3·0 and 5·0 but the greatest buffer action starts at about pH 6·0 The amount of lime (99·5% $CaCO_3$) required to raise the pH from 4·0 to 6·0 ranged from 19 to 23 metric tons per ha, or some 20 tons to raise the pH from 4·6 to 6·2.

* * *

Variety experiments, 1956-57 and 1957-58. ANON. *Victorias Milling Co. Release*, 1959, (24), 10pp.—Tabulated statements are given of the two years' varietal experiments in 1956-57 and 1957-58 with H 37-1933, the leading variety, as standard—it has since been superseded by POJ 3016, less because of the high yield of the latter than because it was the only variety resistant to leaf scorch of which sufficient planting material was available. Eight promising varieties are listed, of which four, with the longest experimental record, Co 440, Co 449, CP 29/116 and N:Co 310, are briefly described.

* * *

Economic aspects of sugar cane farming. A. C. BARNES. *S. African Sugar J.*, 1959, **43**, 497–501.—In this Address to the 32nd Annual General Meeting of the South African Sugar Growers' Association, the whole series of field practices is reviewed in the light of securing good yields and high sucrose content To this review is added a brief note on by-products.

* * *

The importance to the Argentine sugar industry of early maturing varieties. R. F. de ULLIVARI and CARLOS M. GUERINEAU. *Rev. Indust. Agric.*, (Tucumán), 1957, **41**, 1–30.—Juice quality of 8 early maturing varieties, taken at frequent intervals throughout the season, is presented in tabulated form. The comparison is with Tuc 2645, and all 8 were found to be superior.

* * *

The value of field residues of sugar cane as forage. E. A. BRAGADÍN and H. B. DÍAZ. *Rev. Indust. Agric.*, (Tucumán), 1957, **41**, 31–36.—Data and the quantity of silage made from cane tops and trash are given and suggest that it offers a solution to the problem of feeding stock over the critical months. An illustrated account of the development is given by the same authors in Circular 158 of the Tucumán Agricultural Station (1959).

* * *

Progress report of chemical weed control in sugar cane over the past 10 years. E. R. STAMPER. *Paper presented to the American Soc. Sugar Cane Tech.*, 1959.—2,4-D was first used for the control of alligator weed in sugar cane with considerable success. The paper records how that success has led to the substituted problem of the control of grasses, in particular Johnson grass, with its dual mode of spread, rhizome and seed, and it records briefly the latest recommended practices.

* * *

"Endrin" for sugar cane borer control—a look into the future. L. D. NEWSOM. *Paper presented to the American Soc. Sugar Cane Tech.*, 1959.—This paper gives a balanced discussion of the pros and cons of chemical control in general and, in particular, in the case of the borer. Much of the argument is based on experience gained in the cotton fields. The scales come down in favour of chemical, as opposed to biological, control in spite of the risks of upsetting the balance of Nature and of breeding resistant races of the pest.

[1] *I.S.J.*, 1958, **60**, 315.

NEW SYSTEM OF EVAPORATION IN THE SUGAR INDUSTRY

The L.V. System

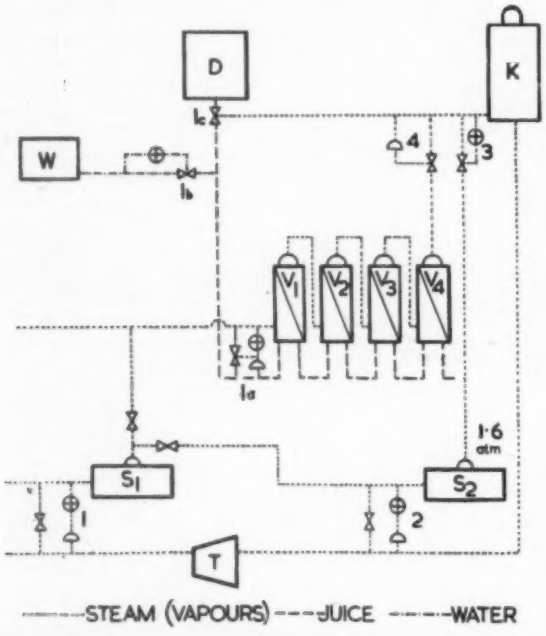
By DIPL. ING. W. G. DE PROSKOWETZ

PART II

CONTROL OF THE SYSTEM

Since the L.V. system employs (preferably) a quadruple-effect evaporator and only vapours from the last effect are used for heating and pan boiling, each effect evaporates almost the same amount of water. The system demands in principle increasing heating surfaces from first to last effect and small temperature differences between effects.

The amount of last vapours is practically identical with the amount of heating steam entering the first effect, which results in very simple mathematical proportions and easy control, especially as the amount of thick juice (T) is always in fixed proportion to the thin juice (t) - ($T = t - nV_1$) - and also the Brix of thick juice (Bx_T) is always proportional to the thin juice Brix (Bx_t): $Bx_T = \frac{100\,d}{t - nV_1} = \frac{100\,t\,Bx_t}{t - nV_1}$ where d = apparent dry substance in thin juice, n is the number of effects and V_1 the evaporation in the first (and therefore every) effect. The term nV_1 replaces $\Sigma V_1 + V_2 + \ldots V_n$ for the usual evaporator set.



Key to Fig. 6.—K = vacuum pans; D = thin juice supply tank; V_1—V_4 = evaporator; T = turbine; S_1, S_2 = steam accumulators I and II; 1_c = valve between T and S_1; 2 = valve between T and S_2; 3 = valve between pans K and S_2; 4 = valve throttling thin juice when the last vapour pressure rises; 1a = flowmeter or combined flow-and Brix meter; 1b, 1c = valve arrangement for water supply in case of thin juice supply failure.

As in nearly all existing control schemes, the main control in the L.V. system is based on the proportion of thin juice to heating steam and, to some extent, on the Brix of thick or middle juice. A very large number of control systems are mentioned in the literature, including those of G. FLETCHER & CO. LTD. and J. EISNER[9], A. C. CAMP[10], CAMP and SLATER[11], SOC. FRANC. DE CONSTRUCTION MECANIQUES[12,13], and especially that of HONIG and LINE[14], perhaps the best approach as yet to an efficient evaporation control system. All these systems, some[12,13] using vapour re-compression, employ the pressure of the vapours as the impulse as well as the amount of thin juice and, in most cases, the Brix of thick juice and the relationship between these values, as in the systems of MURRAY[15], TAYLOR and HONEYWELL[16] and SCHMOLE[17]. MURRAY[15] uses the comparative weighing of juice and water columns. W. S. YOUNG[18] developed a control method for juice levels in the evaporator with the aid of steam coils. ZAGRODZKI[19] has carried out a survey of the existing control systems for quadruple effect evaporator systems. Where exhaust steam for heating purposes must be made up with live steam, the amount of the latter must naturally be controlled and DE MARBAIX[20] in his system extended this control also to intermediate evaporator effects.

To compensate for the fluctuations between steam production and demand steam accumulators are of great value. Their accumulating capacity naturally depends on the difference in pressure and is approximately as follows:

from 25 to 4 atm	130 kg steam/cu.m. water
„ 15 „ 4 „	95 „ „ „
„ 10 „ 4 „	65 „ „ „

This is not a specific feature of the L.V. system, but can be used here with great advantage, whereas a second steam accumulator, charged at exhaust pressure and discharging at the last vapour pressure, is a specific feature of the L.V. system and is an object of a claim in the patent specification covering the system. Its capacity from 4 atm to 0·6 atm is 53 kg steam per cu.m. water. The main control of the L.V. system is defined by the parameters thin juice, thick juice (Brix and quantity), and heating steam. The impulse transmitter between thin juice and heating steam may be a simple flowmeter or a combined flow- and Brix-meter, the first permitting extremely simple proportions, but with variations in the thick juice Brix from 60° to 70°; the second gives a constant thick

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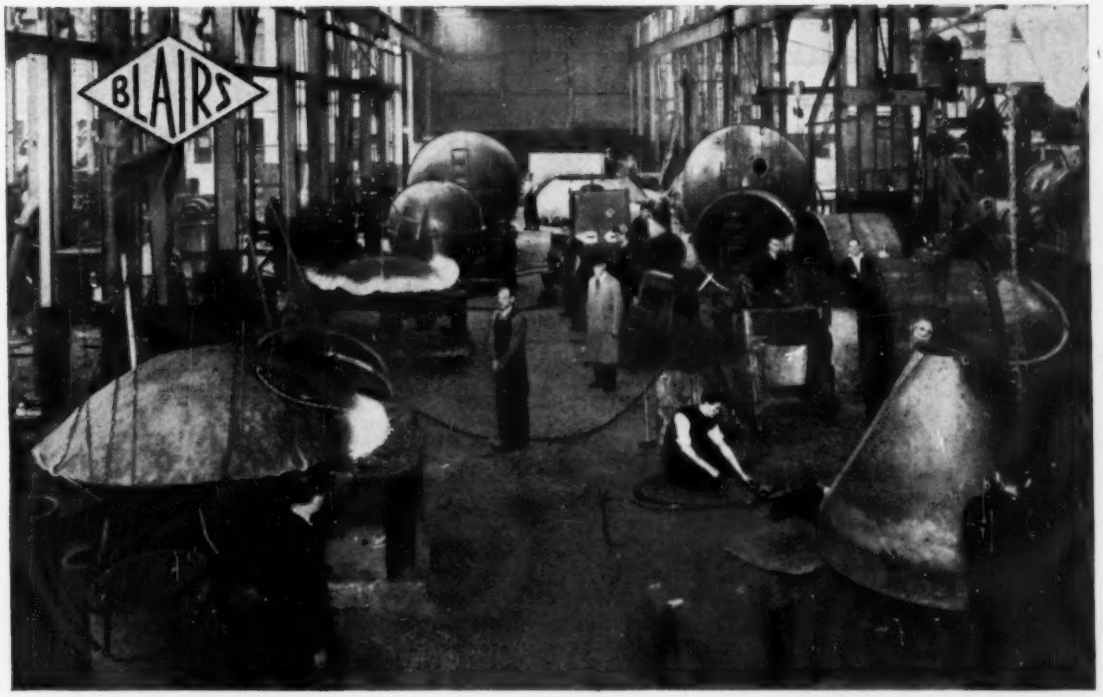

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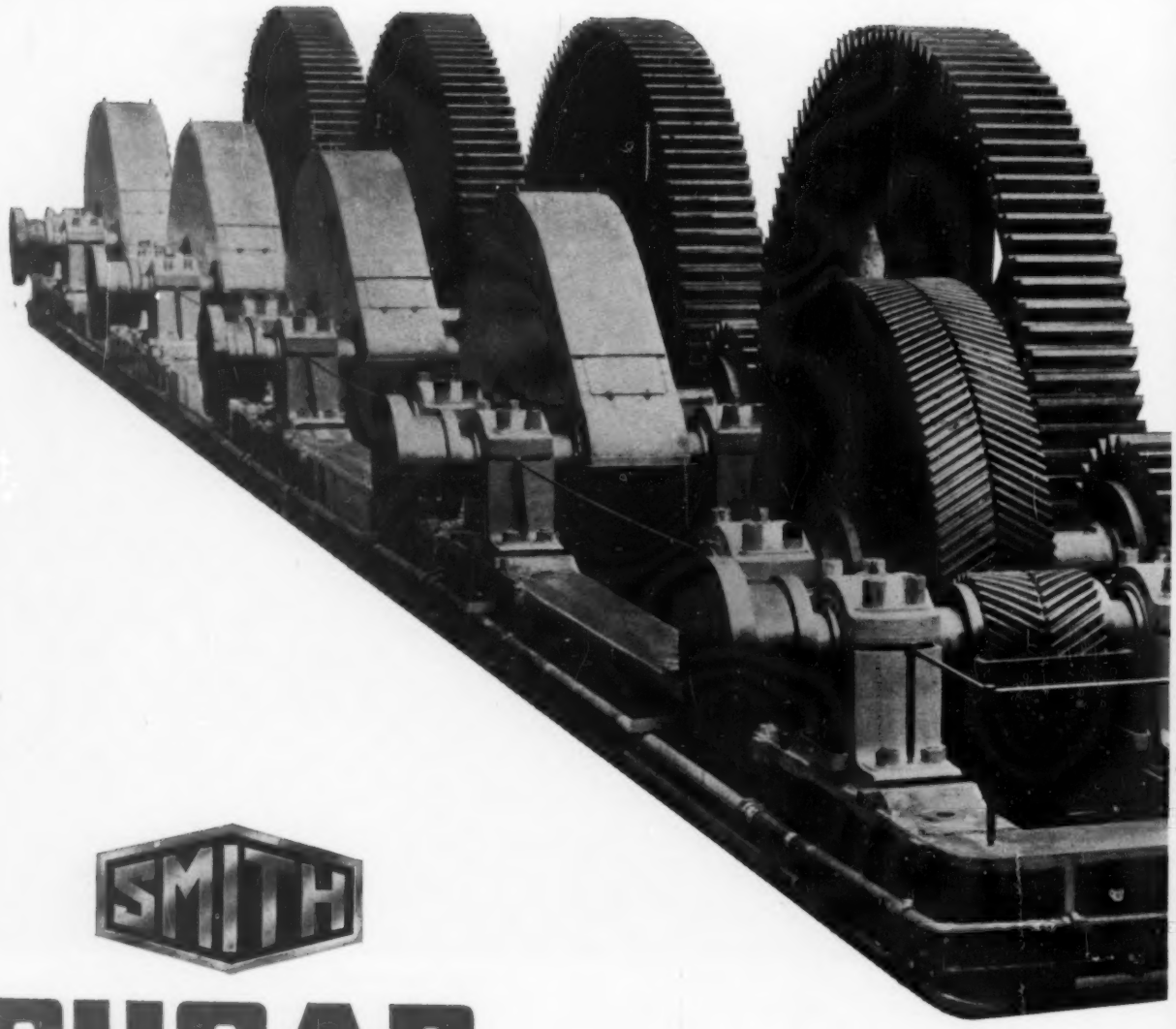

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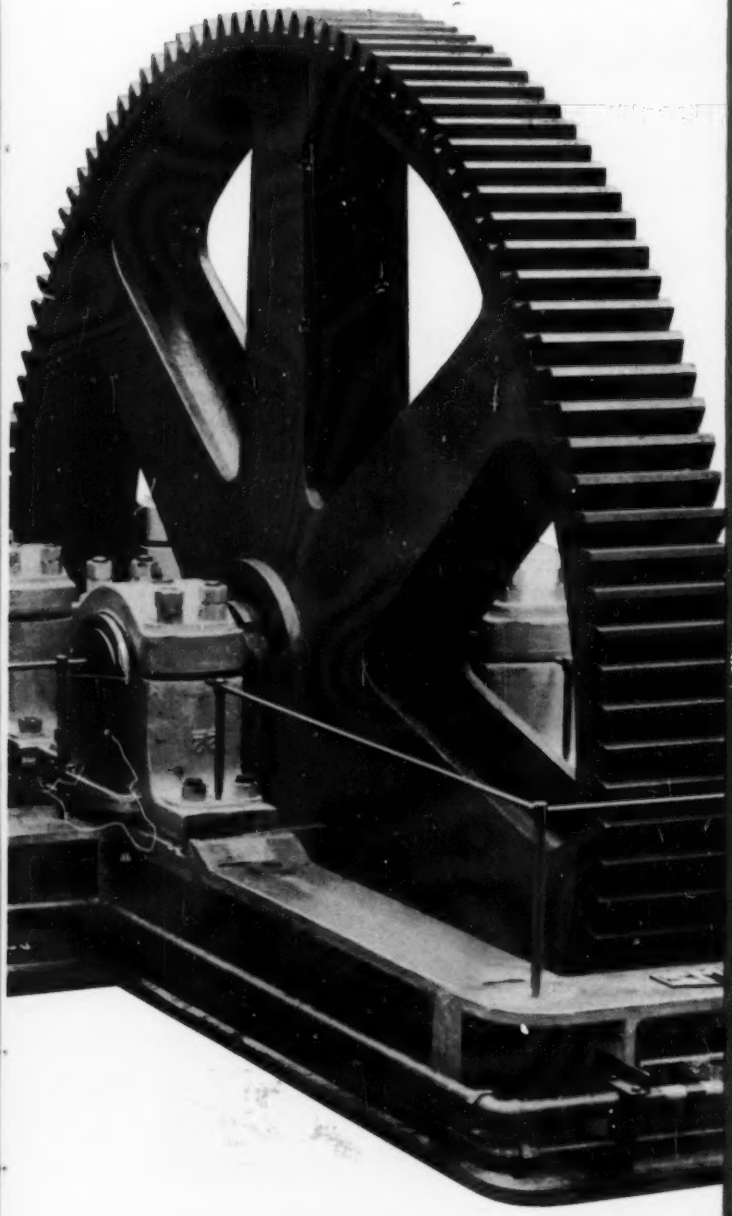

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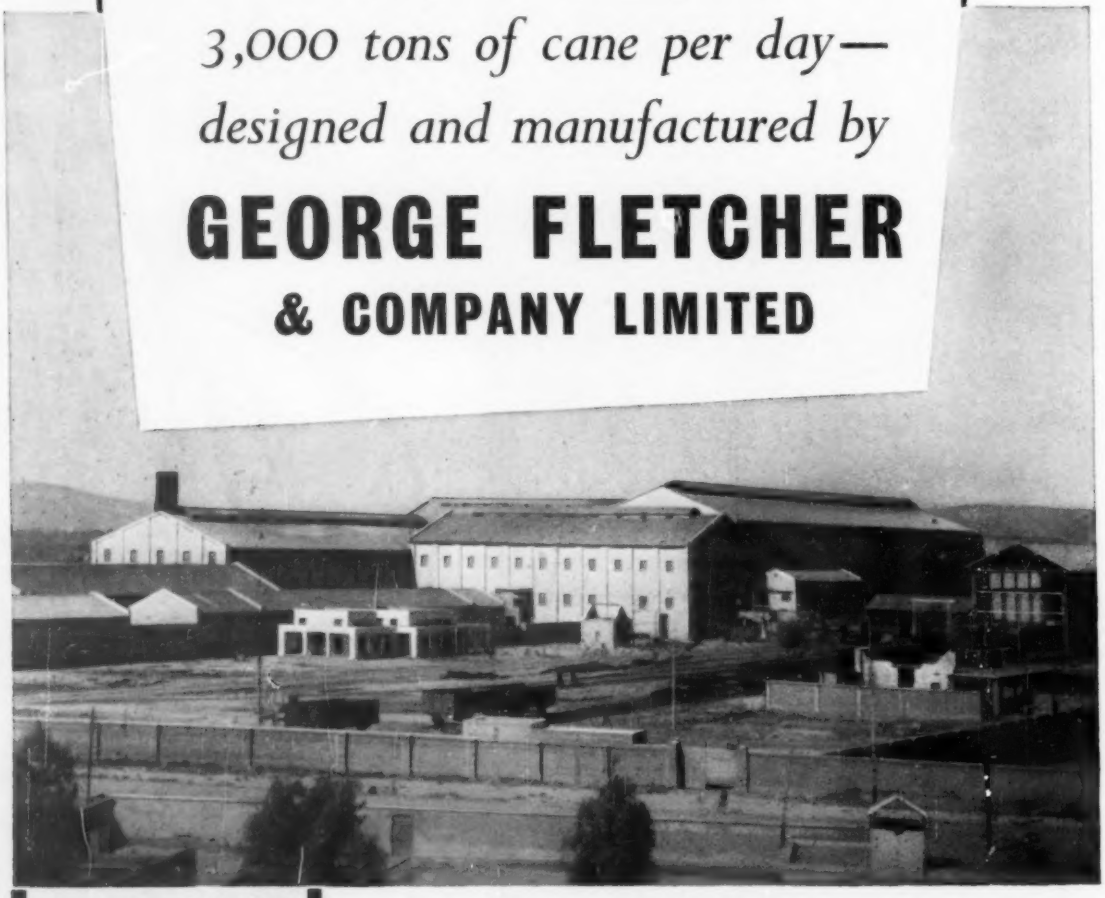

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juice Brix with varying proportions between juice and heating steam. The difference is shown in the figures given below for a quadruple-effect evaporator.

Simple Flowmeter

Bx*t*		Dry subst. /juice	Evaporation *T*	% beet	Ratio *T* : *t*	Bx*t*
		Juice % beet 120				
12·0	.....	14·4	24·0	24·0	5 : 1	60
12·5	.....	15·0	24·0	24·0	5 : 1	62·5
13·0	.....	15·6	24·0	24·0	5 : 1	65
		Juice % beet 130				
12·0	.....	15·6	26·0	26·0	5 : 1	60
12·5	.....	16·25	26·0	26·0	5 : 1	62·5
13·0	.....	16·9	26·0	26·0	5 : 1	65

Combined Brix and Flowmeter

Bx*t*						
		Juice % beet 120				
12·0	.....	14·4	22·15	24·46	5·41:1	65
12·5	.....	15·0	23·07	24·23	5·2:1	65
13·0	.....	15·6	24·00	24·00	5·0:1	65
		Juice % beet 130				
12·0	.....	15·6	24·0	26·5	5·41:1	65
12·5	.....	16·25	25·0	26·25	5·2:1	65
13·0	.....	16·90	26·0	26·0	5·0:1	65

A main feature of the L.V. system is the switching of the pans to the position of last steam consumer by means of an overflow valve in the last-vapour main, so as to ensure priority for the diffusion system and heaters. Further, to avoid disturbing the whole control system, the amount of last vapours to the pans must always be too small, actuating the discharge valve of the steam accumulator II. The devices employed are well known and very simple.

Fig. 6 illustrates the general layout of the control system. Only certain of the devices form part of the L.V. system and have been included in the patent specification.

[9] U.K. Patent 587,122; *I.S.J.*, 1950, **52**, 25.
[10] *Sugar*, 1950, **45**, (6), 26–27; *I.S.J.*, 1951, **53**, 19.
[11] *Instrumentation*, 1949/50, **4**, 18–19.
[12] Fr. Pat. 981,556 (1951).
[13] Fr. Pat. 989,182 (1951).
[14] Dutch Pat. 72,241 (1953); see also *I.S.J.*, 1958, **60**, 115.
[15] *I.S.J.*, 1956, **58**, 273–275.
[16] *Zucker*, 1952, **5**, 263–264; 1958, **11**, 504.
[17] German Pat. 915,920 (1955).
[18] *Sugar*, 1953, **48**, (3), 48–50; *I.S.J.*, 1953, **55**, 248.
[19] *Gaz. Cukr.*, 1958, **60**, 105–108; *I.S.J.*, 1959, **61**, 22.
[20] *Compt. rend. VII Congr. Ind. Agric.*, 1948, **1**, (2), 22–24.

THE DETERMINATION OF THE IONIC CALCIUM CONTENT OF CLARIFIED CANE JUICE

By PETER HIDI and R. I. NICHOLSON

(Research Department, The Colonial Sugar Refining Co. Ltd., Sydney, Australia.)

Introduction

THE completeness of the interaction of calcium with phosphate ions in limed cane juice is of importance to the cane sugar industry in regard to both clarification and raw sugar filtrability. Kerr[1] has recognised that the solubility of calcium phosphate is much higher in juice than in water and we have found the solubility in juice is from 10 to 18 times higher than in similarly limed synthetic solutions containing the same amounts of sucrose, reducing sugar, phosphate, potassium and hydrogen ions.

These facts indicate an incomplete precipitation of phosphate from the juices due to both the binding of the calcium ion by substances naturally present and to interaction of other ions with the phosphate.

This paper deals with the first aspect of the problem and it is proposed to discuss the other and quantitatively more important effects in a future publication.

Cane juices, like solutions from other biological systems, contain substances which are able to form complexes with calcium ions. There are a number of methods for the determination of the calcium content of juices[2,3]; the most recent are based on complexometric titrations[4,5]. None of those methods differentiates between ionic and non-ionic calcium. For measuring the ionic calcium a method had to be chosen which did not disturb the original $\text{calcium}_{ionic} \rightleftharpoons \text{calcium}_{non\text{-}ionic}$ equilibrium.

Several methods are described in chemical literature for similar problems. These include measurement of:

(a) an electrode potential which is a uniformly increasing or decreasing function of the calcium ion concentration of the solution[6,7].

(b) the physical properties of stearic acid monolayers[8].

(c) equilibria reached on ion-exchange resins[9] or

(d) change in the solubility of slightly soluble calcium salts[10].

All of these methods were found completely unsuitable for juices, mainly owing to interferences.

The only suitable method for our purposes appeared to be a colorimetric method based on metal indicators which underwent a marked colour change specific for

calcium ion. The method is quite analogous to that employing acidimetric indicators for measuring pH which are well known in the sugar industry[11]. We have adapted the methods employed by RAAFLAUB[12] on cerebrospinal fluid and by SMEETS and SEEKLES[13,14], on milk ultrafiltrate. Their methods are suitable only for colourless solutions which do not contain traces of interfering heavy metal ions; the procedure described below overcomes these difficulties.

THEORETICAL

Murexide (ammonium purpurate), a well-known calcium indicator[15], has a red-violet colour in the neutral pH range which changes to yellow-orange in the presence of calcium ion. This is shown schematically in equation (1).

$$\underset{\text{red-violet}}{H_2\,Purp^-} + Ca^{++} \rightleftharpoons \underset{\text{yellow-orange}}{Ca\,H_2\,Purp^+} \quad \ldots\ldots\ldots(1)$$

The extinction curves of free and calcium-bound murexide are shown in Fig. 1.

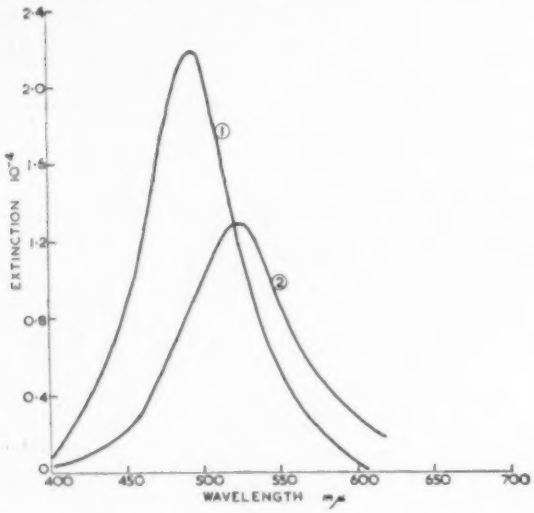

Fig. 1.
1. Extinction curve of calcium purpurate complex.
2. Extinction curve of ammonium purpurate.

The equilibrium can be expressed quantitatively according to equation (2).

$$\frac{[Ca^{++}]\,[H_2\,Purp^-]}{[Ca\,H_2\,Purp^+]} = Kd \quad \ldots\ldots\ldots\ldots\ldots(2)$$

where [ ] represents concentration of reactants in very dilute solution (when the activity coefficient is 1) and *Kd* is the dissociation constant of the $Ca\,H_2\,Purp^+$ complex.

From equation (2)

$$Ca^{++} = \frac{[Ca\,H_2\,Purp^+]}{[H_2\,Purp^-]}\,Kd \quad \ldots\ldots\ldots\ldots\ldots(3)$$

According to the Lambert-Beer law, at a suitable wavelength (470–500 mμ)

$$[Ca\,H_2\,Purp^+] = C(E_x - E_o) \quad \ldots\ldots\ldots\ldots\ldots(4)$$

where E_x is light extinction measured in presence of the complex, E_o is extinction measured in absence of the complex and C is a constant.

$[H_2\,Purp^-]$ is obtained by subtracting the concentration of the dye in complex form from the total dye concentration ($[\Sigma\,Purp]$).

$$[H_2\,Purp^-] = [\Sigma\,Purp] - [Ca\,H_2\,Purp^+] \ldots\ldots(5)$$

Total dye concentration is:

$$[\Sigma\,Purp] = C_1\,[E_\infty - E_o) \quad \ldots\ldots\ldots\ldots\ldots(6)$$

where E_∞ is extinction when all the dye is in complex form. This is achieved by adding a large excess of calcium chloride to a standard amount of dye. C_1 is a constant.

If the measurements are made under exactly similar conditions (wavelength, cuvette size and dilution), $C = C_1$ and therefore from equations (4), (5) and (6)

$$[H_2\,Purp^-] = C(E_\infty - E_o) - C(E_x - E_o)$$
$$= C(E_\infty - E_x) \quad \ldots\ldots\ldots\ldots\ldots(7)$$

Applying (4) and (7) to equation (3):

$$Ca^{++} = \frac{E_x - E_o}{E_\infty - E_x}\,Kd \quad \ldots\ldots\ldots\ldots\ldots(8)$$

The value of *Kd* obtained from the literature[15] is 0·004, but small deviations may be caused by changes in experimental conditions, e.g. pH, ionic strength, etc. Thus, for accurate measurements *Kd* in equation (8) should be determined with a known amount of calcium ion employing the described conditions.

EXPERIMENTAL

Reagents:

(1) 0·005M standard $CaCl_2$ solution
(2) 1·0M $CaCl_2$ solution
(3) 1·5N KCl solution
(4) 0·0015M EDTA solution (disodium ethylene diamine tetraacetate)
(5) 0·05N HCl
(6) 0·05N KOH
(7) 0·02N acetic acid/acetate buffer (pH adjusted to 6·5)
(8) 4% murexide on KCl carrier.

Murexide solution was prepared by dissolving 0·1 g (approx.) of a 96:4 KCl:murexide powder in 100 ml acetic acid/acetate buffer solution. The rate of dissolution was increased by raising the temperature of the solution to 40°C and stirring. After

[1] *Tech. Rpt.*, (Sugar Research Institute, Queensland), 1952, (10).
[2] HONIG: Principals of Sugar Technology, Vol I, Ed. P. HONIG (Elsevier, Amsterdam). 1953, p.323.
[3] GEE *et al.*: *Anal. Chem.*, 1954, **26**, 1487; *I.S.J.*, 1956, **58**, 143.
[4] BENNETT AND SCHMIDT: *I.S.J.*, 1958, **60**, 225.
[5] NICHOLSON: *C.S.R.Co. Research Rpt.*, 1958. (unpublished).
[6] GREENBERG: Advances in Protein Chemistry, Vol 1. Ed. M. L. ANSON and J. T. EDSALL. (Academic Press, New York.) 1942. p. 121.
[7] MARSHAL: *J. Phys. Chem.*, 1944, **48**, 67.
[8] HAVINGA: *Chem. Weekbl.*, 1942, **39**, 594.
[9] CRISTIANSON *et al.*: *Anal. Chem.*, 1954, **26**, 1923.
[10] NORDBÖ: *J. Biol. Chem.*, 1939, **128**, 745.
[11] SPENCER AND MEADE: Cane Sugar Handbook, 8th Edn. (Wiley, New York). 1945. p. 458.
[12] *Z. Physiol. Chem.*, 1951, **288**, 228.
[13] *Nature*, 1952, **169**, 802.
[14] *Netherlands Milk and Dairy J.*, 1955, **9**, 249.
[15] SCHWARZENBACH AND GYSLING: *Helv. Chim. Acta*, 1949, **32**, 314.

one hour the solution was filtered to remove the small amount of undissolved dye particles. (Slow destruction of the dissolved dye prevented the use of the same solution for longer than 2–3 days.)

Method.—50 ml clarified juice is filtered through Whatman No. 1 paper and 15 ml aliquots of the filtrate pipetted into two 50-ml beakers (I and II). To each is added 2 ml 0·0015M EDTA solution.

Into a third beaker (III) is pipetted 15 ml 0·005M $CaCl_2$ solution, 15 ml of distilled water into a fourth beaker (IV) and 10 ml 1M $CaCl_2$ solution into a fifth beaker (V).

One ml 1·5N KCl is added to III and IV, 5·0 ml murexide solution is added to II, III, IV, and V, and 5·0 ml of buffer solution is added to I.

The solutions are then diluted to the same approximate volume and the pH of the solution adjusted to 6·5 with a few drops of 0·05N HCl or KOH.

The solutions are then quantitatively transferred to 25-ml volumetric flasks and made to volume with distilled water.

Readings of light extinction (-log transmission) are made on a suitable spectrophotometer, such as the Hilger H 700—308, at 485 mμ using 40-mm glass cuvettes. Solution II is read using solution I as blank and solutions III, IV and V are read against a distilled water blank.

The value of *Kd* is calculated by substituting the extinction readings obtained in the equation:

$$Kd = \frac{E_\infty - E_y}{E_y - E_o} \frac{15}{25} 0{\cdot}005$$

where $E_y = E_{III}$

$E_o = E_{IV}$

$E_\infty = E_V$

$\frac{15}{25}$ is the dilution factor.

Using the *Kd* factor thus obtained, it is possible from reading II to calculate the calcium ion concentration of the juice from equation (8) applying factors for the juice dilution and the correction for the EDTA (+ 0·1 m mol.litre).

Results are in terms of moles/litre.

Observations

Interference.—Interference caused by the colour of the juice itself must be eliminated. This is achieved by measuring the extinction against a blank solution of the juice which contained all reagents except murexide.

The pH adjustment, particularly of the juice samples, must not vary more than 0·03 units as the colour of the juice changes rapidly with pH in the neutral range and it is therefore essential that the pH of the test solution and blank should be the same. A pH of 6·50 was selected for most of the measurements but any pH in the range 6·0–7.2 may be used if desired. Readings at the higher end of the pH range showed that at wavelengths around 485 mμ the absorption of the juice itself increased rapidly with increasing pH.

The dilution of the juice samples also requires great care as the absorption of the juice itself is 2–20 times as great as the absorption difference caused by the calcium ions.

Materials which might be expected to interfere with the colorimetric determination were examined:

Magnesium forms a much weaker complex with murexide than does calcium and, therefore, it has practically no adverse effect even when the quantities added are three times as great as the calcium present in the juice.

The addition of 1·5 milli-equivalents of aluminium, 0·2 milli-equivalents of manganese (Mn^{3+}) or 0·5 millimole of a phosphate salt does not affect the accuracy of the determination.

No significant effects are observed on adding sucrose and invert sugar in quantities of 20% and 5% respectively.

Dissolved iron gives a strong colour reaction with the natural juice dyes, but by applying the blank correction no significant effect on the purpurate can be observed, due, presumably, to the fact that most of the iron is not in the ionic state.

Copper ion interacts strongly with murexide and therefore small amounts can greatly affect the determination. It has been pointed out[16] that the amount of copper present in juice after normal clarification is less than 2 p.p.m., but even this amount of copper is enough to affect the accuracy of the analysis. Neither potassium cyanide nor triethanolamine has been found suitable to eliminate its effect. Mn^{3+} has an effect similar to, but smaller than, that of Cu^{2+}.

The addition of stock EDTA solution to obtain 0·2 mmolar EDTA in the undiluted juice filtrate has been found to eliminate effectively the interference of Cu^{2+} and Mn^{3+}. This amount of EDTA was enough to complex these ions without affecting the bulk of calcium ion by appreciably altering the equilibrium. Half of the EDTA present is added as a correction when calculating the calcium ion concentration. This procedure cannot cause an error greater than 0·1 m mol/litre in the final result.

The addition of murexide indicator will, in theory, alter the ionic calcium-nonionic calcium equilibrium. Calculation of the effect from *Kd* value and indicator concentration shows it to be much smaller than the accuracy of the determination and therefore no correction for added indicator is necessary.

Stabilizing the pH by addition of buffer has been found desirable. A suitable buffer, having sufficient buffering capacity in the neutral range and not forming either a precipitate or a complex with calcium, was difficult to find. A 0·02M acetic acid/acetate buffer is not strong enough to bring the pH to a common level, but it increases the buffer capacity of the system sufficiently to allow for final adjustment of pH with 0·05N HCl or KOH and to give a steady pH after adjustment.

[16] Honig: Principals of Sugar Technology, Vol. I. Ed. P. Honig. (Elsevier, Amsterdam). 1953. p. 350.

For the measurement of E_o values it is necessary to prepare a juice which does not contain calcium ions. This was first done by adding sufficient excess of calcium complexing material, sodium citrate or EDTA, to the juice and also to the blank. It was later found better simply to add the indicator solution to a 0.1N KCl solution instead of to juice and read against a water blank. The results thus obtained (20 measurements with standard deviation of 1·6%) agree within 1·2% with the citrate complexed measurements (12 measurements with standard deviation 2·9%), and within 1·8% with the EDTA complexed measurements (8 measurements with standard deviation 3·9%). The replacement of juice by KCl solution therefore does not cause any error. In fact, it increases the accuracy of the measurements.

As a result of similar experiments, water has also been used instead of juice for the E_∞ measurements.

Table I

TOTAL AND IONIC CALCIUM CONTENT OF CLARIFIED JUICE FILTRATES

No.	*Variety*	*Ionic Calcium millimol/ litre*	*Total Calcium millimol/ litre*	*Non-ionic Calcium (by difference) millimol/ litre*
1	Trojan	4·4	3·5	0·9
2	Trojan	6·6	5·0	1·6
3	Trojan	4·0	3·7	0·3
4	47 BN 1843	6·4	5·2	1·2
5	47 BN 1843	8·2	6·6	1·6
6	Vesta	3·8	3·1	0·7
7	Vesta	8·4	3·9	4·5
8	Trojan	3·9	3·0	0·9
9	Trojan	2·8	2·8	0
10	Vesta	2·7	1·2	1·5
11	Vesta	3·1	1·7	1·4

RESULTS AND DISCUSSION

Table I shows the results of determinations of calcium ion concentration in some clarified juice filtrates. The probable error of these results is estimated as 0·15 millimoles/litre or approximately 5%. For comparison the total calcium content of these clarified juice filtrates is also given.

These figures show that there was a great variation in the amount of bound calcium campared with the total amount of calcium in the juice filtrates (0–56%). The variations in the amount of bound calcium are probably the result of the variations in the amounts of ligands present in the juices, but the materials which form stronger complexes than calcium (e.g. iron) must also influence it.

Table II

EFFECT OR DEGREE OF LIMING ON TOTAL, IONIC AND NON-IONIC CALCIUM

No.	*pH of Clarified Juice*	*Σ Ca millimol/ litre*	*Ca++ millimol/ litre*	*Non-ionic Ca millimol/ litre (by difference)*
1	6·4	3·1	1·6	1·5
2	6·8	3·3	2·7	0·6
3	7·2	3·9	3·4	0·5
4	7·6	4·9	4·4	0·5
5	8·0	6·2	5·5	0·7

Table II illustrates the results of a series of calcium determinations carried out on juice from one cane variety (Vesta). All samples were limed hot with increasing quantities of lime, boiled, settled and the supernatant juice filtered.

In Table II, the concentration of non-ionic calcium is highest at the lowest pH. This is related mainly to the higher solubility of the calcium phosphate increasing the availability for the calcium ions for complex formation with the ligands present. On increasing the amount of lime the non-ionic calcium concentration decreases and appears to pass through a minimum in the pH range 7·2–7·6, i.e., the pH range recommended by the sugar industry for clarified juice. At higher pH the non-ionic calcium level rises owing to the total calcium maintaining the $Ca_{ionic} \rightleftharpoons Ca_{non-ionic}$ equilibrium.

Other calcium and ionic calcium determination in clarified juice filtrates limed to different pH values do not always show the high non-ionic Ca level reported in the first line of Table II. On the other hand, in filtrates from overlimed juice, the non-ionic calcium level is always found to be higher than in juices limed to normal pH.

The non-ionic calcium will obviously behave quite differently from the ionic calcium during subsequent processing. However, it should be recognised that a $Ca_{ionic} \rightleftharpoons Ca_{non-ionic}$ equilibrium always exists and tends to oppose any changes occurring during further processing which would alter the relative concentrations of ionic and non-ionic calcium.

Summarizing the analytical results, from a number of clarified juice filtrates it was found that a large proportion of calcium is not in the ionic state.

On the other hand, the differences between total and ionic calcium only partly explain the increased solubility of calcium phosphate found in juices[4,17]. The greater part of this solubility increase is due to the interaction of the phosphate with other constituents of the juice. We propose to discuss this in a further paper.

SUMMARY

A rapid colorimetric method has been applied for determining the concentration of ionic calcium in clarified cane juice filtrates by measuring the light absorption of the calcium purpurate complex. Interference by substances usually present in the clarified juices could be successfully eliminated. The ionic calcium level was found to range from 44 to 100% of the total calcium content of the filtrate.

ACKNOWLEDGMENTS

The work described in this paper was carried out in the Research Department of The Colonial Sugar Refining Co. Ltd., Sydney. The authors wish to thank the Management of the Company for permission to publish this paper. Thanks are also due to Miss G. McIntyre for assistance in the preparation of this paper.

[17] NICHOLSON *et al. C.S.R.Co. Research Rpt.*, 1958. (unpublished).

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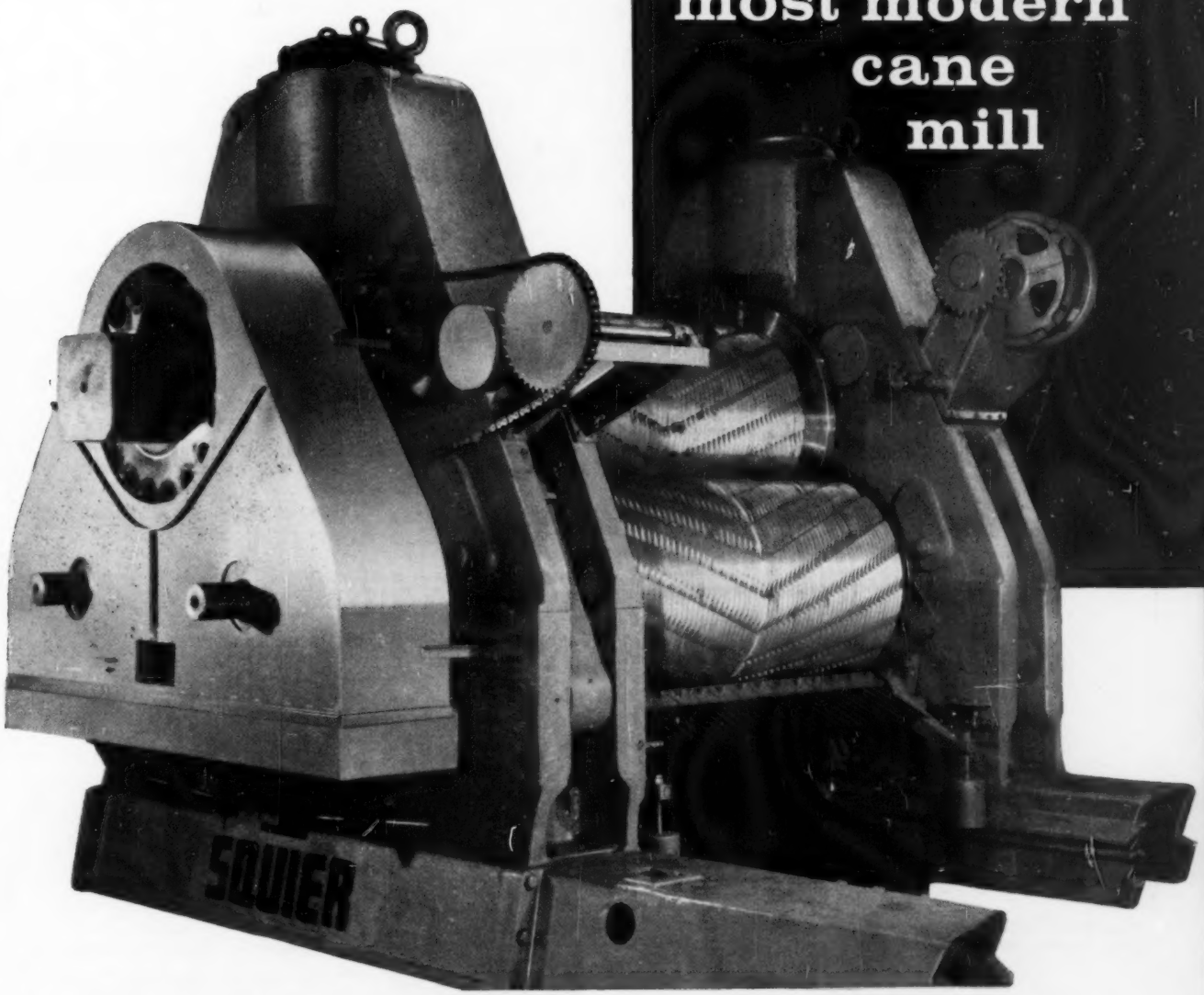

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THE EFFECTS OF CALCIUM AND PHOSPHATE IN CANE JUICE CLARIFICATION

By M. C. BENNETT* and J. M. RAGNAUTH‡

Department of Sugar Chemistry and Technology, Imperial College of Tropical Agriculture, Trinidad, W.I.

PART I

SUMMARY

THE effects of phosphate concentration, calcium concentration and pH on cane juice clarification are measured in terms of settling rate, mud volume and turbidity of clarified juice. The effect of phosphate is shown at constant pH and at a constant calcium concentration in the clarified juice; under these conditions it is found that the phosphate concentration at which flocculation is complete (and turbidity very low) is somewhat greater than that at which the settling rate is a maximum. The optimum phosphate concentration for clarification should therefore lie somewhere between the two.

The effect of calcium concentration is shown at constant pH and constant phosphate concentration; under these conditions it is found that over a fairly narrow range of calcium concentrations in the clarified juice, the settling rate rises to a maximum and the mud volume falls to a minimum. The effect is also shown with Th^{4+}, Ce^{3+} and Mg^{2+} and evidence is presented which suggests that the effect is electrostatic in character.

At constant calcium concentration in the clarified juice and at constant phosphate concentration the effect of pH is found to be small. In juices of appreciable magnesium content there is an increase in mud volume around pH 8.

INTRODUCTION

In 1925 BOND[1] first showed that the result of lime-heat defecation depends largely upon the quantity of calcium phosphate precipitated; he concluded that "defecation is primarily a function of the phosphate content of the raw juice". Since that time much work has been carried out on the inorganic precipitate formed during the clarification process[2–6] and it is now well established that the minimum phosphate level for satisfactory clarification is generally about 300 mg/litre P_2O_5, i.e. 4 mM.

Much less is known about the calcium requirement of a juice, for in the commercial process the lime addition is determined by pH rather than by calcium considerations. It has naturally been assumed that since the (calcium + magnesium) content after liming is always in excess of that required for complete inorganic phosphate precipitation, the calcium requirement is always satisfied. Nevertheless, it has been known for some time[9] that additions of calcium chloride sometimes bring about marked improvements in the flocculation on subsequent liming and it would appear that in such cases some of the original calcium is complexed and therefore unable to take part in the clarification reactions. However, KERR, FOSTER and CASEY[10] have demonstrated that, of the calcium-complexing substances which occur in cane juice, only citric acid forms a complex strong enough to prevent the precipitation of calcium in the presence of phosphate at pH 7; in view of the low concentrations of citric acid which occur naturally, the effect is practically negligible. It therefore seems improbable that juices can be deficient in calcium with respect to phosphate precipitation, although they may be calcium-deficient with respect to some other part of the flocculation process.

In recent papers BENNETT[11, 12] has discussed the mechanism by which precipitated calcium phosphate brings about flocculation of the heterogeneous particle suspension in cane juice; he has suggested that calcium phosphate bridges are established between adjacent particles, attachment of the particles to the precipitate taking place through Ca^{2+} ions which are already bound at the particle surface by adsorbed protein[13]. The number of particles flocculated in this manner depends upon the quantity of phosphate precipitated, and hence there is a phosphate level below which complete flocculation cannot be achieved.

It is possible that calcium deficiencies arise when there are insufficient Ca^{2+} ions bound at the particle surface to ensure strong attachment to the phosphate precipitate; in such cases the particle system will behave like mineral suspensions in which calcium phosphate precipitation does not bring about flocculation[14].

In lime-heat defecation, calcium phosphate precipitation is by no means the only flocculation process taking place; as has been discussed previously[12], the particle suspension can be flocculated simply by heating and boiling without the application of lime. It has been shown that, while each flocculation process modifies to a certain extent the result of the others, the calcium phosphate precipitation exerts a

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[1] *Ind. Eng. Chem.* (*Industrial Edn.*), 1925, **17**, 492; *I.S.J.*, 1925, **27**, 311.

[2] KING: *Ind. Eng. Chem.* (*Industrial Edn.*), 1931, **23**, 954; *I.S.J.*, 1931, **33**, 463.

[3] BEHNE: *I.S.J.*, 1942, **44**, 233.

[4] BLISS: *Sugar J.* (La.), 1952, **14**, (11), 31; (12), 68.

[5] HONIG: "Principles of Sugar Technology", Ed. P. HONIG (Elsevier, Amsterdam). 1953. p. 495.

[6] PAYNE: Ref. 5, p. 504.

[7] DAVIES: Ref. 5, p. 555.

[8] DOUWES DEKKER: *Comm. Sug. Mill. Res. Inst.*, 1954, (25), 9.

[9] FLESHMAN: *Rpts. Assoc. Hawaiian Sugar Tech.*, 1934, 121; *I.S.J.*, 1935, **37**, 158.

[10] *Proc. 23rd Conf. Queensland Soc. Sugar Cane Tech.*, 1956, 59; *I.S.J.*, 1957, **59**, 77.

[11] *I.S.J.*, 1957, **59**, 176, 208.

[12] *I.S.J.*, 1959, **61**, 66.

[13] BENNETT: *Chem. and Ind.*, 1957, 1098.

[14] EVANS *et al.*: *Canad. J. Chem. Eng.*, 1957, **35**, 25.

dominating influence on turbidity in the clarified juice. However, few quantitative data exist concerning the relationship between phosphate content and turbidity and, furthermore, it is not known how the original calcium and phosphate contents affect final settling behaviour.

In the present work a study is made of the effects of calcium and phosphate on the turbidity, settling rate and mud volume obtained by a standard clarification procedure.

Experimental

Except where otherwise stated, cane was cut not more than 24 hours before use. The cane was milled in a laboratory 3-roller mill and the juice obtained was filtered through cotton wool in order to remove coarse material. Additions of calcium and phosphate were made to the raw juice using solutions of calcium chloride and sodium phosphate which had been adjusted to the raw juice pH. The juice samples were then adjusted to pH 8·0 with sodium hydroxide and were heated to boiling. After not less than five minutes, the samples were poured into settling tubes and settling measurements made at 90°C by the method of Schmidt[16]. Settling behaviour was assessed in terms of V (the initial settling velocity), K (an empirical constant also having the dimensions of velocity) and H_∞ (the percentage mud volume). In some of the experiments described below poor flocculation precluded the determination of the V settling rate.

Turbidity was measured by direct determination of the optical density at 650 mμ of a sample of the clarified juice diluted ten-fold in 0·1 M acetate buffer of pH 4·6[11]. The optical density thus obtained was then corrected for the contribution of the colouring matter in the juice, the correction being determined on a bentonite-treated sample of the clarified juice at the same dilution and in the same buffer. Clarified juices were clear to the naked eye at a corrected optical density value of about 0·05. pH measurements were made using an E.I.L. direct reading instrument and optical densities were measured using a Unicam SP400 spectrophotometer.

Calcium and magnesium were determined by EDTA titration[16] and inorganic phosphate was determined by a molybdenum blue colorimetric method[17].

Calcium chloride solutions were prepared from Analytical Reagent grade $CaCO_3$ and the NaH_2PO_4, $Th(NO_3)_4$, $Ce(NO_3)_3$ and $MgCl_2$ referred to later on in this work were also of this quality.

The work described below concerns a study of an extremely refractory B4098 juice; the cane was kindly supplied by Trinidad Sugar Estates Ltd. The investigation is then extended to juice from the following nine varieties of cane grown under normal conditions on various parts of the College Farm: B 37161, B 37172 (both standover cane); B 46102, B 46218, B 45152, B 37161, B 4744, B 47419 and Ajax.

Results and Discussion

The results of changing the total inorganic phosphate content of a B 4098 juice at three different total calcium + magnesium contents are shown in Fig. 1. Since the magnesium content of the raw juice was low (< 5 mM), for convenience the combined calcium + magnesium contents are described as "calcium contents". The results are plotted against the amounts

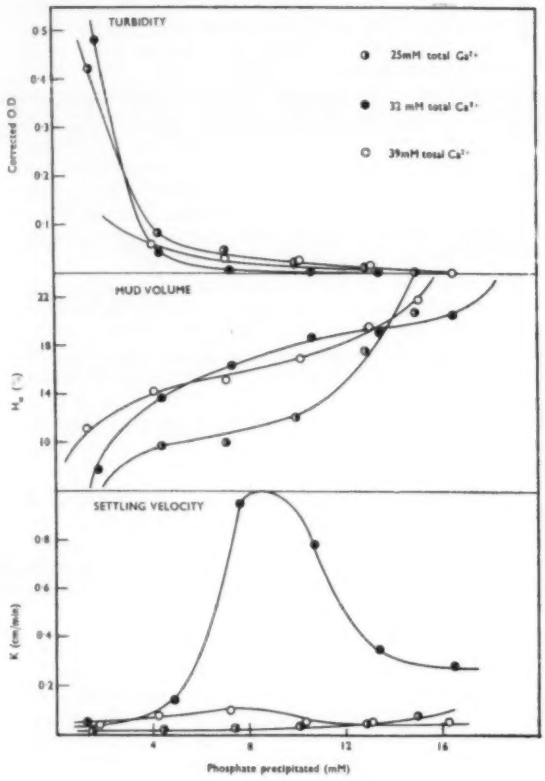

Fig. 1.

of phosphate precipitated which, at the high calcium contents used here, were found to be effectively the same as the total inorganic phosphate contents of the systems. It is seen that, at a Ca^{2+} content of 32 mM, when the phosphate level is about 8 mM there is a large increase in settling rate, an effect which is only just apparent at 39 mM Ca^{2+}, and which is absent at 25 mM Ca^{2+}. The clarified juice turbidities approach a satisfactorily low level (i.e. about 0·05) around 5 mM phosphate precipitated and these are not sensitive to the Ca^{2+} content. Mud volume curves are relatively flat over the phosphate range 4–10 mM; it is seen that the curve for 25 mM Ca^{2+} lies consider-

[15] *I.S.J.*, 1959, **61**, 263.
[16] Bennett and Schmidt: *I.S.J.*, 1958, **60**, 225.
[17] Williams: *Proc. B.W.I. Sug. Tech. Conf.*, 1954, 167; *I.S.J.* 1957, **59**, 225.

ably below the others, but experiments carried out over a wider range of Ca^{2+} contents (15–40 mM) show that the position of the H_∞ curve is apparently independent of Ca^{2+} content and hence the difference seen in Fig. 1 must be attributed to other variations in the raw juice.

In Fig. 2 are shown the effects of changing the total Ca^{2+} content while the phosphate precipitated is maintained within the optimum range of 8·5–9 mM from Fig. 1. Over the range of Ca^{2+} contents used,

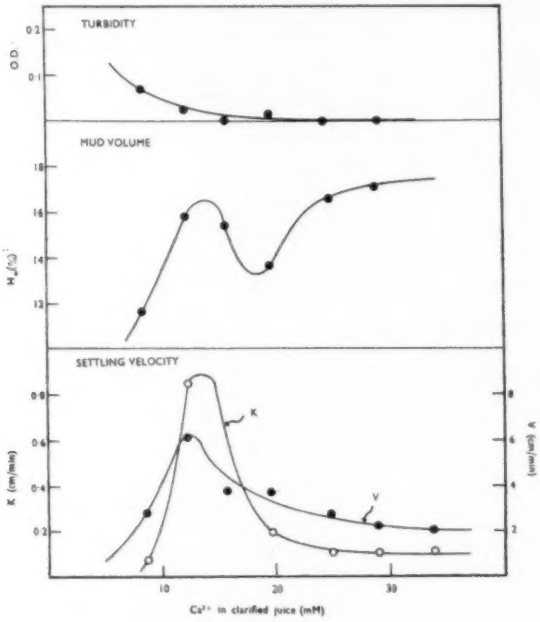

Fig. 2.

the phosphate precipitated varied only between 8·6 and 8·9 mM, while the calcium precipitated varied only between 19 and 21 mM. From these analyses it is clear that the amount of calcium phosphate precipitated is effectively constant over most of the range shown in Fig. 2 and hence the effects must be attributed to changes in Ca^{2+} concentration *in the clarified juice*; the results in Fig. 2 are shown plotted against clarified juice concentrations.

The well defined peak in settling rate at 12 mM Ca^{2+} is accompanied by marked changes in the mud volume, while the turbidity is satisfactorily low even at the smallest Ca^{2+} concentration. This type of behaviour is reproducible provided that the experiment is carried out at the optimum phosphate value, as found from a settling curve of the type shown in Fig. 1; it is often found that the trough in the mud volume curve coincides exactly with the peak in settling rate. At phosphate levels other than the optimum, the effect of Ca^{2+} concentration on settling rate is diminished (as expected from the settling rate *vs.* phosphate-precipitated curve in Fig. 1), while the marked effect on mud volume disappears.

It is apparent that the results shown in Fig. 1 are the sum of two effects, one due to the change in quantity of calcium phosphate precipitated, the other due to a change in the Ca^{2+} concentration in the clarified juice. In order to examine the effect of phosphate content it is therefore necessary to carry out the experiment at a constant Ca^{2+} concentration in the clarified juice and hence the calcium requirement of the added phosphate must be introduced together with the phosphate. In the present work the Ca^{2+} requirement was determined from preliminary experiments such as those described above, Ca^{2+} and phosphate analyses allowing the Ca^{2+}/PO_4 ratio in the precipitate to be calculated for each required Ca^{2+} concentration in the clarified juice. Generally it was found that the Ca^{2+}/PO_4 ratio increased as the Ca^{2+} concentration increased but the value usually lay

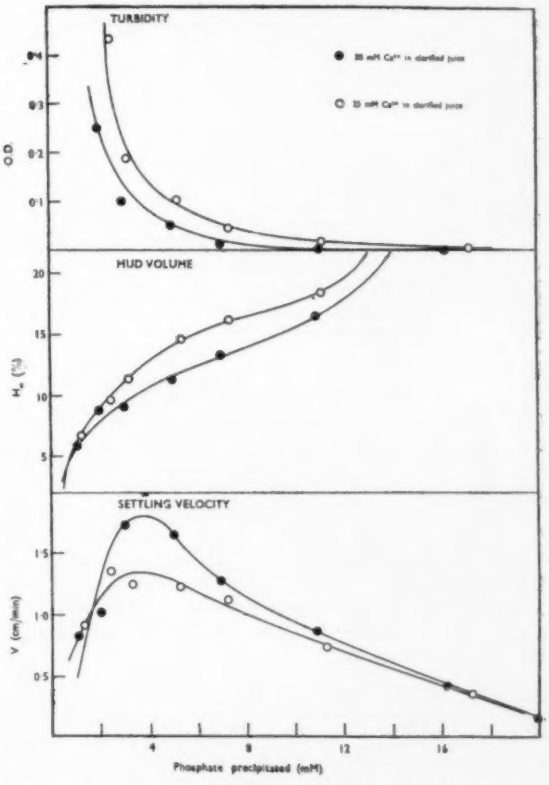

Fig. 3.

between 1·5 and 2·5. The results of such experiments, examples of which will be given below, show that, as expected, the effect of phosphate is greatest when the Ca^{2+} concentration is at the optimum value and vice versa.

Both the optimum phosphate level and the optimum Ca^{2+} concentration increase with the age of the cane after cutting: 1 day old cane showed the peak settling rate at 12 mM Ca^{2+} (Fig. 2), 4 days old cane, at 18 mM Ca^{2+}, while 8 days old cane showed the peak at 30 mM

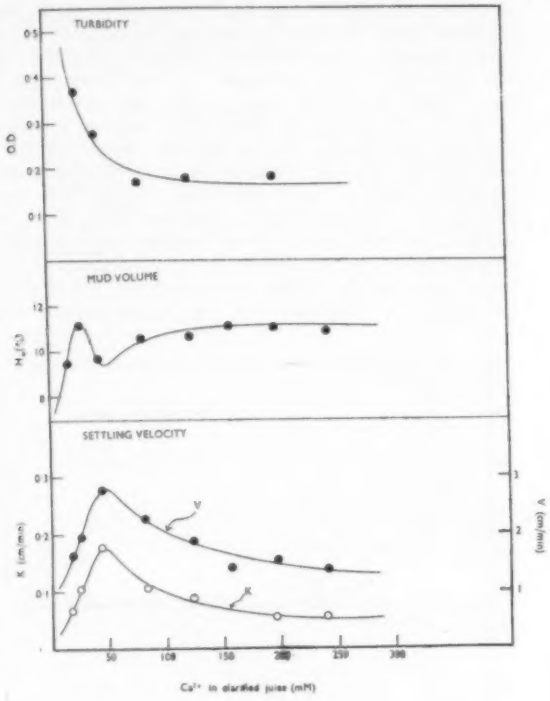

Fig. 4.

Ca^{2+}. Similarly, as will be shown in figs. 3 and 4 below, it was found that 4 months after the results in Figs. 1 and 2 were obtained, the optimum phosphate level had decreased from 8·5 to 4·0 mM while the optimum calcium level had increased from 12 to 50 mM. All cane used for these experiments was picked at random from the same part of one field. Because of these changes it was always necessary to carry out preliminary experiments in order to locate approximately the optimum Ca^{2+} and phosphate levels.

The results expressed in Fig. 3 show the effect of phosphate level at two Ca^{2+} concentrations in the clarified juice. The maximum settling rate occurs at 4mM phosphate precipitated and has a larger value at 33 mM Ca^{2+} than at 25 mM Ca^{2+}. These Ca^{2+} concentrations are considerably greater than that shown to be the optimum in Fig. 2. The results in Fig. 4, obtained from the same juice at a phosphate level of 3·4 mM, show that the optimum Ca^{2+} concentration had in fact increased to 50 mM. The trough in the mud volume curve is however coincident with the maximum settling rate and, as shown, there is no further change in either of these properties up to 250 mM Ca^{2+}. The extremely high turbidity is to be expected from the turbidity curve of Fig. 3; it would have been necessary to carry out the experiment with 5 mM phosphate precipitated in order to have achieved satisfactorily clear juices.

(to be continued)

TAIWAN SUGAR CROP 1958-59[1]

The 1958–59 sugar crop in Taiwan was the biggest since the end of World War II, but because of the low sugar price on the world market, the farmers are not so enthusiastic about planting cane as in the previous year and it is certain that the 1959/60 crop will be lower. The total sugar production was 939,862 metric tons, tel quel, or about 970,000 metric tons, raw value, comprising 431,681 tons of SWC (superior white crystals), 70,338 tons of BWC (B-grade white crystals), 434,284 tons of RSC (raw sugar crystals) and 3559 tons of brown sugar. The previous crop of 1957/58 produced 893,987 metric tons, tel quel, itself a record.

The 1958/59 crop was produced from 7,726,000 metric tons of cane, harvested from a total area of 91,148 hectares. This gives a cane yield of 84·6 tons of cane per hectare, while the yield of sugar on cane, as 96 pol sugar, was 12·6% or about 7·96 tons of cane per ton sugar. In the previous crop, the yield of cane per hectare was 76·9 tons and, although the sugar yield on cane was higher at 13·1%, the yield of sugar per hectare was higher in 1958/59 at 10·6 compared with 10·0 tons.

The yield of cane from the Corporation's land was 80·8 tons/ha, compared with 86·2 tons from contracted farmers. This was due to a number of causes: first that the farmer grows his cane in small plots and devotes more attention to it; he is able to operate a crop rotation system and so maintain a higher fertility; and also post-war Government policy encouraged farmers to own their land so that the Corporation was forced to seek other lands for cane growing and these were naturally in less fertile parts of the country.

All factories operated, although four small factories were combined into two bigger ones so as to reduce costs and overheads. The total grinding capacity is 55,000 tons per 24 hr, and the campaign lasted 140 days on average, although one factory crushed for only 108 days and another for 189.

[1] J. C. HUANG: *Taiwan Sugar*, 1959, **6**, (7), 13.

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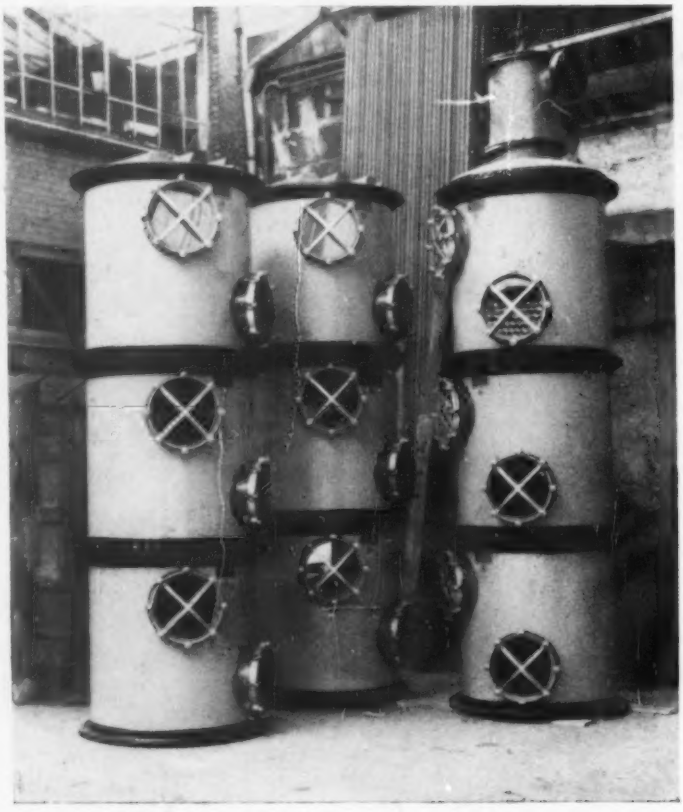

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At Aguadilla: the bulk sugar loading terminal. ANON. *Sugar J.* (La.), 1959, **23,** (1), 45–47.—Cf. *I.S.J.*, 1958, **60,** 151; 1959, **61,** 143.

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Reducing the running-down period at sugar factories. E. A. GUSEV. *Sakhar. Prom.*, 1959, (6), 15–17.—To increase the time available for repairs at Krasnopresnensk refinery without reducing the production time of 11 months in the year, a scheme was proposed and first used in August 1958 whereby the time taken to process materials in the refinery after intake had ceased and to clean and wash out all refinery equipment before repairs were made was reduced from 8 to 4 days. Losses were reduced from 0·91% to 0·71%.

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Engineering aspects of sugar mill drive modernization in the Hawaiian Islands. J. A. DOVE and G. L. JORN. *Paper presented to the Amer. Soc. Sugar Cane Tech.*, 1959.—An account is given of the examination and evaluation of the existing drives at Kekaha and Lihue where mill engines were to be replaced by steam turbines. The selection and characteristics of the replacement gearing are described, and data sheets given for five drive layouts.

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Economic value of mechanical circulation in vacuum pans. W. T. ABERCROMBIE. *Paper presented to the Amer. Soc. Sugar Cane Tech.*, 1959.—The mechanical circulator and its advantages are described and discussed. The time required to complete a strike is cut, pan capacity is increased, the number of pans reduced and final molasses more completely exhausted.

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Entrainment, its causes and prevention. K. N. AGARWAL and S. G. PRASAD. *Indian Sugar*, 1959, **9,** 77–80.—Causes of entrainment are listed and diagrams given of various types of save all. A separator is described consisting of 40–80 folds of chicken-wire netting, 4–6 inches thick, held between metal sides bolted between iron rings. It has proved satisfactory when installed in the bodies of a triple effect evaporator.

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Practical exhaustibility of some Indian molasses. G. H. JENKINS and V. GURUSWAMY. *Sharkara*, 1959, **2,** 19–26.—Laboratory tests are reported on exhaustion of two Indian and two Queensland molasses samples, stirred slowly at 40°C in the presence of about 30% of fine crystals of about 0·4 mm. It was quite practicable to exhaust to 1·03 supersaturation within a reasonable time and the viscosity of the molasses was such that the massecuite could be handled readily in a modern centrifugal. The Indian molasses was originally considerably above the "expected purity" according to the Douwes Dekker formula, and could have been better exhausted in the factory. It is recommended that full analysis of the molasses be carried out as routine for determining the degree of exhaustion by the Douwes Dekker formula, apparent purity being quite inadequate.

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Prevention of entrainment: design of save-alls. C. G. M. PERK. *S. African Sugar J.*, 1959, **43,** 606–607.—Modifications are described which make a previously-described design[1] more efficient.

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SO_2-gas producer and cooler for tank sulphitation using impure sulphur as raw material. C. G. M PERK. *S. African Sugar J.*, 1959, **43,** 615–617.—Types of sulphur burner are reviewed and that adopted for Umfolozi refinery sulphitation plant is described. It comprises a refractory-lined steel cylinder with a conical base of refractory bricks on which molten sulphur is sprayed. Air is admitted at the bottom while SO_2 discharges from the top. The gas temperature depends on the excess air and radiation losses, but is reduced rapidly from e.g. 655°–790°C to 300°C in air-cooled stainless steel coils, and then to about 70°C in a rack-type cooler made of graphite blocks with external cooling by water spray.

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Comparative steam consumption in remelting with water and clear juice. C. G. M. PERK. *S. African Sugar J.*, 1959, **43,** 617–621.—The savings in steam are recalculated and compared with those calculated by SANYAL[2], but assuming a quadruple effect evaporator instead of a triple-effect and a melt of 72° and not 60° Bx. The savings as between juice and water are reduced from 0·39% on cane to a negligible 0·094%. A drawing and description is given of the Prins-Steuerwald continuous melter installed at Umfolozi, and another small melter for reject sugar is also briefly described.

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Grain size in raw sugar factories. J. A. CLARK and F. GARCÍA LÓPEZ. *Sugar y Azúcar*, 1959, **54,** (8), 25–26, 37.—A series of calculations are used to develop a formula relating raw sugar size with purities of syrup, molasses, crystallizer massecuite, and sugar, and raw sugar. A series of lines on a graph illustrate the formula and specific problems are worked with its aid.

[1] *I.S.J.*, 1953, **55,** 335.
[2] *I.S.J.*, 1959, **61,** 80.

Preventing corrosion under severe conditions. ANON. *Sugar y Azúcar*, 1959, **54**, (8), 27.—Hull corrosion of steel barges used at the bulk shipment terminal at Monymusk has been prevented by the application of two coats of "Rust-Ban 270" and a top coat of "Rust-Ban 297" supplied by Esso Standard Oil S.A.

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Sugar in the Dominican republic. H. R. SHAW. *Sugar y Azúcar*, 1959, **54**, (8), 28–29.—A brief illustrated account is given of some aspects of the Dominican Republic sugar industry.

* * *

Microbiological purity is unpredictable. W. L. OWEN. *Sugar y Azúcar*, 1959, **54**, (8), 33–34.—Although refined sugar is more consistently satisfactory according to canners' standards of microbiological contamination, infection is still erratic and unpredictable. Maintenance of consistently low infections will only be attained by frequent bacteriological analyses.

* * *

Automatic control of melt station in refinery operation. F. CORDOVEZ Z. *Sugar J.*, (La.), 1959, **22**, (2), 23–25.—An account is given of the automatic control of melter operations at Central El Palmar, Venezuela. Discharge of sugar (washed A and B raws) is governed by the bin level, while melt Brix is regulated by a Foxboro bubbler-type density recorder-controller, which governs the sweet water addition. A Foxboro temperature recorder-controller regulates the heating coil steam valve. Melt is pumped to a tank from which it is sent to another where it is treated with "dry sugar acid". Following this it passes to another tank where caustic soda is added under pH control. It overflows to a treated melt tank from which it is drawn off to process. If the melt in this tank rises to the top, a level control causes the flow through the acid and alkali treatment tanks to stop. The melt then rises in the melt pump tank and on reaching the top causes a level detector to stop the sweet water and sugar feeds to the melter.

* * *

Utilization of the ion-exchange process in sugar refining. VII. The relation between regenerating procedures and the behaviour of inorganic substances adsorbed from sugar solutions on to the strong basic anion-exchange resins. S. IWASHINA. *J. Agric. Chem. Soc. Japan*, 1959, **33**, 163–166; through *S.I.A.*, 1959, **21**, Abs. 471.—Four kinds of anion-exchange resins (R≡NX type) that were colour contaminated were examined spectroscopically and the concentration of Fe, Mn, Mg and Cu contained in the regeneration effluents were determined. The above metals shorten the life of resins regenerated with oxidising agents; NaOCl is less effective than HCl for regeneration. Experimental results show that about 54% of the contaminating Fe was removed by HCl (triple washing of the resin with 2½ times the volume of *N*-acid), whereas hardly any Fe was removed by NaOCl.

Clarification and demineralization of Egyptian cane blackstrap molasses. A. M. GAD and A. S. EL-NOCKRASHY. *Egypt J. Chem.*, 1958, **1**, 399–411; through *S.I.A.*, 1959, **21**, Abs. 473.—Analysis of molasses (from Abou-Korkas factory) showed that the ash contained mostly potassium and calcium salts; the aconitic acid content was relatively high (6·29%). Centrifuging of the 1:1 diluted molasses removed suspended matter (1·07% of the molasses), and this comprises 60·26% of silica. Ion-exchange purification of the centrifuged molasses could remove 94·35% of the ash, but increased the reducing sugar content from 10 to 27%. Chemical methods were also examined. By precipitation of calcium with sulphuric acid, mixing at 70°C for 12 hr and centrifuging, 98% of the calcium could be precipitated when a pH of 3·7 was reached. Treatment of the residual molasses solution at 10–15°C with aluminium sulphate for 12 hr gave a potash alum precipitate which represented a removal of only 71% of the potassium present. Treatment of diluted (original) molasses with excess tartaric acid, and stirring for 36 hr, gave precipitates of potassium and calcium tartrates representing 93·4% of the potassium and 71·05% of the calcium initially present. The precipitation was greater when the dilution of the molasses was kept low. Double carbonatation and (single) sulphitation of diluted and centrifuged molasses, followed by concentration under vacuum, enabled 40·46% of the ash and 55·34% of the aconitic acid to be removed; the ash removal included 36·34% of the potassium, and 27·50% of the calcium initially present.

* * *

Experience in processing highly-coloured granulated sugar. M. ABDULAKH. *Sakhar Prom.*, 1959, (7), 26.—Highly-coloured granulated sugar is first treated in the raw factory. It is melted to 45–50° Bx at 80–85°C. The melt is limed with 0·5–1·5% CaO by weight on sugar, and gassed with CO_2 and SO_2. The syrup is filtered, treated with active carbon, and again filtered. After further active carbon treatment it is sent to the refinery, being added either to the white sugar melter to raise its density to 65–68°Bx or sent to the pans. The mother liquor is passed through bone char with 1st refinery syrup and sent to the 1st raffinade pans Satisfactory colour reduction was achieved.

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Mechanized line for packing refined sugar in bags. V. A. CHEREDNIK and B. G. KOLESNIK. *Sakhar. Prom.*, 1959, (7), 48–52.—Full details are given of a mechanical line for weighing and bagging refined sugar.

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The sources and the pol balances of a sugar factory. S. B. DATTA. *Indian Sugar*, 1959, **9**, 125–126.—A sudden increase in undetermined loss, according to the pol balance, was shown not to be real when using a sucrose balance. It is attributed to a sudden abnormality in juice composition which had vanished by the time crystallization had taken place so that molasses analysis was normal.

BEET FACTORY NOTES

The deliming of thin juices. G. A. PAPARELLE. *Materie Plasty*, 1958, **24**, 213–217; through *S.I.A.*, 1959, **21**, Abs. 377.—Operational results with a 3-tower ion-exchange plant (capacity 110–150 tons of thin juice per hour) in a sugar factory in northern Italy are described. The cation-exchange resin used was "Kastel C 300" (Soc. Montecatini) operating on the sodium cycle. The treatment of the juice, washing and regeneration in countercurrent are described, and some figures are tabulated. Good results were achieved, together with some decolorization and reduction of viscosity in the juice, massecuite and molasses.

* * *

The sugar factory of tomorrow. E. DORMAL. *Ind. Sacc. Ital.*, 1959, **52**, 155–159.—The operation of Belgian factories is compared with other European countries and the use of continuous and automatic devices and methods in beet processing are reviewed. The importance of the introduction of continuous operation is briefly discussed.

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Technical progress in the British sugar industry. J. CAMPBELL MACDONALD. *Ind. Sacc. Ital.*, 1959, **52**, 167–179.—The development of the British beet sugar industry from its inception in 1912 is surveyed and an account given of recent modernization of factories with the consequent improvement in results—these are illustrated by means of tables and graphs.

* * *

Existence, importance and control of biological losses in sugar production. M. DRACHOVSKÁ and K. SANDERA. *Ind. Sacc. Ital.*, 1959, **52**, 180–196.—Biological losses—those other than physical, chemical and mechanical—are in the majority in beet sugar production. Among these is the "loss" considered as the difference between the yield of sugar economically possible (8·17 tons/ha) and that achieved in practice (5·04 tons/ha). This is partly due to the effect of seed quality and a conductimetric examination of seed extracts and diffusates can be used as a gauge of quality. γ-ray irradiation of seed and growing and stored beet has been only partially successful in improving the beet crop and its sugar content and keeping qualities. The use of pesticides requires lengthy and costly field trials. However, laboratory tests are of considerable help and the authors' biochemical method[1] is suitable. The respiration of beet is considered from a theoretical basis and equations are developed for the losses involved. Losses by diffusion from beet into wash and transport water is set at 20% of the total loss from field to the slicers. Biological losses in diffusion lead to a fall in pH and consequent corrosion; a method is described for conductimetric control of the process.

* * *

Purification of beet juice and utilization of the waste products. J. VASÁTKO and R. KOHN. *Ind. Sacc. Ital.*, 1959, **52**, 197–207.—While simple liming gives floc dimensions of only 5 mμ, a particle size of 70 mμ can be achieved by recycling over-saturated juice in the Dedek-Vasátko method of progressive preliming. The various preliming and recycling systems are reviewed. The electrokinetic potentials of $CaCO_3$ particles in $Ca(OH)_2$/sucrose solutions and in 1st carbonatation juice are illustrated in the form of graphs. The Dorr defeco-saturation and Stanek-Pavlas fractional saturation techniques are examined, and the authors' views on what happens during recycling of saturated juice into raw juice are discussed. The preparation and uses of V-K chalk are described[2].

* * *

Technological development of juice purification. G. D'ORAZI. *Ind. Sacc. Ital.*, 1959, **52**, 214–223.—Technological progress in clarification in recent years has been with the object of mechanization and automatic operation. At the same time a greater understanding of the process has been achieved by application of modern physico-chemical views, and an extension of this has been the development of preliming as well as simple lime treatment to attain the optimum flocculation of colloids. Continuous first carbonatation with recirculation to obtain an easily separable precipitate requires much care; and the use of some modern systems of defeco-saturation and clarification, followed by filtration in continuous rotary filters, has led to a drop in juice quality. The author anticipates a return to the classical system with the possible replacement of filter presses by a continuous thickening filter and followed by rotary filters without decantation. Second carbonatation is a less complex process than the first, the important point being determination of the "optimum" point corresponding to the level of decalcification. Filtration of 2nd carbonatation juice is discussed with particular reference to ceramic filters, and flow diagrams are given for a simple process and a predefecation plus mud recirculation system involving their use. The use of ion exchange resins for treatment of thin juice or molasses is also considered; economically the process is doubtful at the moment, but the author considers that this problem will be solved in the future.

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White sugar. G. GISMONDI. *Ind. Sacc. Ital.*, 1959, **52**, 224–229.—Consumption sugar in Italy is of two types: refined sugar and crystal sugar, the latter a straw coloured washed raw of at least 99·6 pol, used mainly by industry. Refining was once carried out exclusively with bone char, but today vegetable carbons and chemical reagents—hydrosulphite, etc.—are used. The refining process is reviewed briefly, from affination to packeting and storage, and reference is made to conditions necessary in silo storage and to production of sugar cubes and tablets.

[1] *Listy Cukr.*, 1954, **70**, 32; 1955, **71**, 166–169; 1956, **72**, 221–252; 1957, **73**, 55–58; 1958, **74**, 19–21, 29–35.

[2] *See I.S.J.*, 1959, **61**, 59.

Concentration and Boiling. G. MALAGUZZI-VALERI. *Ind. Sacc. Ital.*, 1959, **52**, 237–240.—Technical developments in the evaporation and boiling of sugar juices have as their object the maximum fuel economy and quickest operation. As a result, a higher temperature has been adopted for multiple evaporator first effects, and the evaporators have been redesigned to prevent sugar destruction. High pressure boilers and machinery have been introduced, while pans capable of working quicker and at lower temperatures have come into use. Massecuites are now subjected to forced cooling, while another measure has been the adoption, where necessary, of vapour compression.

* * *

New equipment for the reception and washing of beet in the sugar factory. L. PALESTRO. *Ind. Sacc. Ital.*, 1959, **52**, 241–246.—The most modern systems of unloading and storing beets (dry mechanical, hydraulic and combined systems and their modifications) are reviewed.

* * *

Diffusion. G. PIERONI. *Ind. Sacc. Ital.*, 1959, **52**, 247–253.—Post-war improvements in beet sugar factories, in diffusion and previous stages are surveyed, with particular reference to modernization of beet slicers, as well as the use of disinfectants to reduce losses. The improvement of diffusion following introduction of continuous diffusers is described and ideal conditions for their working are discussed, including juice velocity, aseptic working, automatic control, etc.

* * *

Accelerated battery diffuser operation. P. M. SILIN. *Sakhar. Prom.*, 1959, (6), 7–10.—The nomogram given previously for diffuser calculations[1] has been extended to cover losses of up to 12% instead of 7% as formerly and values of γ from 1·6 instead of 3. For battery diffusers, additions to the previous table include a draught of 100%, a last cell temperature of 60°C and data for both 8-cell and 16-cell batteries. Sample calculations are given, showing the change in retention time and losses for variation in working conditions.

* * *

Purifying carbonatation juice with ion exchangers. V. M. VOLOKHVYANSKII. *Sakhar. Prom.*, 1959, (6), 10–15.—The problems of ion exchange treatment are discussed and criticism made of the views of G. S. BENIN[2] who advocates treating only part of the juice. The various practices in Soviet factories are discussed and possible future developments are foreseen: regeneration of the resins with ammonia solution, with recovery and re-utilization of the ammonia[3], and the use of resins on the sodium cycle for removal of lime salts and surface-active substances including coloured bodies. The treatment of refinery syrups with resins instead of bone char is also considered.

Storing, conveying and unloading sugar beet. S E. FRIDMAN. *Sakhar. Prom.*, 1959, (6), 19–21.—Clamp protection, transporting of beet in special ventilated rail wagons, the most suitable unloading equipment and ventilation of beet piles are discussed.

* * *

Mechanization of beet unloading and piling in 1958. V. A. NOVIKOV and N. M. KICHIGIN. *Sakhar. Prom.*, 1959, (6), 22–30.—Several types of equipment for beet unloading and piling are described and recommendations are made as to the suitability of these machines on the basis of operational data.

* * *

Fundamentals of density control in multiple-effect evaporators. T. BALOH. *Zeitsch. Zuckerind.*, 1959, **84**, 239–241; 329–336.—Fluctuations in thick juice density are caused by variations in thin juice quantity and density and in the amount of vapour bled. Theoretical equations and flow diagrams are presented to show the effect of changes on these factors; variation in vapour bleeding has a much greater effect than changes in the other two factors. Fluctuations in any or all of the factors can be compensated by transfer of vapour from one effect to a subsequent effect, and equations are given for calculation of the amount to be transferred. To minimise the required total heating surface of the evaporator it is better to transfer the vapour from an earlier effect; this is illustrated by a flow diagram for a triple-effect unit where vapour transfer from the 1st to the 2nd effect corresponded to 4100 sq.m. h.s. compared to 4350 sq.m. when vapour was transferred from the 2nd to the 3rd effect. The possibility of thick juice density control by elimination of fluctuations in the above factors, by adjusting vapour bleeding to the required evaporation or vice-versa, or a combination of these, is discussed with the aid of flow diagrams. Numerous examples and factory experiences are discussed, with 15 references to the literature, and it is shown that for juice level control it is necessary to regulate the feed and not the discharge.

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Decolorizing ion exchangers. VII. Activation of ion exchangers. V. VALTER, K. CIZ and J. STAMBERG. *Listy Cukr.*, 1959, **75**, 155–158.—Factory tests, on a scale of 1/100th of the normal factory capacity, were made to determine the effects of activation of the resins on decolorizing capacity and to establish optimal activation conditions. Treatment of the amphoteric resins ("Wofatit E", 5 A and "Central 291") with 0·1 N-0·3 N HCl is illustrated by tabulated results. Syrup and thick juice was treated by the ion exchangers after activation. Activation with a concentration greater than 0·1 N HCl at an amount greater than 0·05 g.equiv./litre of resin resulted in formation of invert and low syrup pH. Treatment of the resin with a 1·5% solution of NH_4Cl of pH 6·5–8,

[1] *I.S.J.*, 1958, **60**, 144.
[2] See *I.S.J.*, 1958, **60**, 301.
[3] Cf. U.S. Patent 2,678,288; *I.S.J.*, 1954, **56**, 358.

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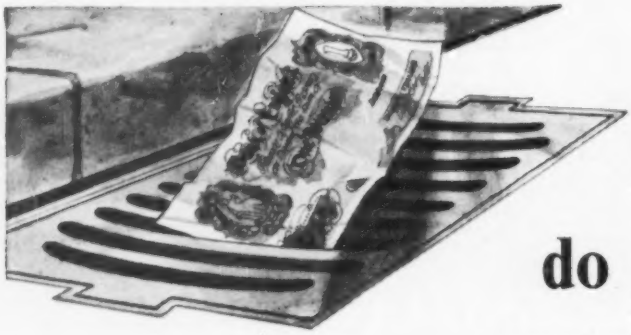

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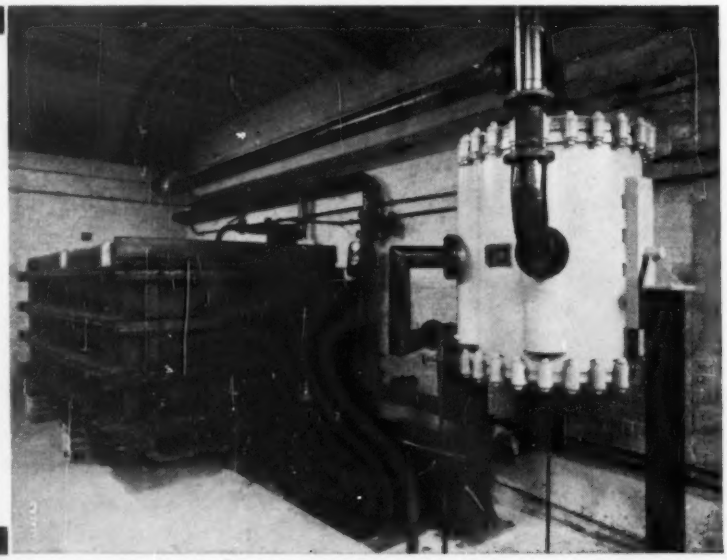

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was found to give the same adsorptive capacity as activation with HCl at low values, the optimal pH being >7·5, to give a minimum pH of decolorized syrup of e.g. >7·8. For best results, the difference between the pH of the treated syrup and that of the activation solution should be <1. The resin should be treated with 3–4 vols, and washed with water until the Cl^- in the eluate has dropped to a suitable level. The same recommendations are made regarding the weakly basic ion exchangers (1A and 1M).

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Protection of diffusers against corrosion. O. BÖHM and O. LISY. *Listy Cukr.*, 1959, **75,** 161–162.—Tests in 1958/9 in which various paints were applied to an R.T. and a Robert diffuser showed that the best system for corrosion resistance is one coat of S 2300, an epoxide with zinc chromate base, and two coats of S 2321, a white gloss enamel.

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Operation of the D.d.S. diffuser. J. SZADKOWSKI and S. JARZECKI. *Gaz. Cukr.*, 1959, **61,** 170–173.—A D.d.S. trough diffuser[1] installed in Goslawice sugar factory in 1958 is described and some performance data are given. Mean temperature in the diffuser was 68°C (65° at the feed end and 60° at the discharge end) and average pH was 6·2 (6·0 at the feed end and 6·6 at the discharge end). Previously the mean pH was 5·4 (5·7–6·3), but 10 litres of 40% formalin was added every 6hr (4 hr towards the end of the campaign) to maintain the higher pH mentioned above. A Ward-Leonard unit controls the speed of rotation of the blades within the range 0·4–1·2 r.p.m. Average losses for the campaign were 0·33% on beet at a draught of 106·5% (0·09% at 120% draught) and an average daily throughput of 1425 tons of beet (maximum 1555 tons). The economics of installing the diffuser are compared with the savings effected. The campaign was shortened by 7 days and several other benefits were gained.

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Fluid level control in open tanks. J. BROWKIN. *Gaz. Cukr.*, 1959, **61,** 173–175.—The system described comprises a ratiometer with the "transmitter" and "receiver" about 30 m apart. Each comprises a sickle-shaped iron bar connected at each end to a magnet. The iron bar of the "receiver" also carries a mirror attached by spindle. The sprocket chain of a counter-balanced float passes over the sprocket wheel of the "transmitter". Movement of this causes, through a worm gear, movement in the spindle carrying the iron bar. Changes in the field are transmitted to the "receiver" and the mirror is rotated through the same angle as the spindle at the transmitting end. A light source throws its beam onto the mirror, and this is reflected onto a dark, calibrated screen. Thus, any changes in the angle of the mirror means a change in the angle of reflection and the indicator reveals changes in the fluid level of the tank.

Pre-defecation in Witaszyce sugar factory. K. KOPERA, E. WALERIANCZYK and A. JARZECKI. *Gaz. Cukr.*, 1959, **61,** 175–179.—A modified defecation scheme is described. Whereas the raw juice was formerly pre-limed in successive measuring tanks, it is now pre-limed in a double-trough liming tank before passing to the main defecation vessels. From the second of the two main liming tanks 25% of the limed juice on beet is returned to the progressive liming trough. Retention time in the trough is 12 min and thorough mixing is ensured by the agitator. The same amount of lime is added as under the old scheme (1·6%) and the alkalinity is about 0·2% CaO (pH is about 11). Automatic control of the amount of limed juice returned to the raw juice, by means of a float in a measuring chest off the progressive liming tank, was ineffective, as large amounts of foam entered the measuring chest. The new scheme has a favourable effect on the performance of the 1st filters, and the losses of sugar in the muds and the colour have fallen. The one disadvantage of the system is the large amount of space it occupies. Much foam collects between the dividing screens of the trough and the construction of the trough cells prevents its removal during operation.

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Experiments with the "Cuitometer" boiling control apparatus at Alpulla. *Seker*, 1959, **8,** (31), 9–18.—The use of the "Cuitometer" conductivity instrument at Alpullu is described with the results recorded in the form of tables and strip-charts.

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Heat insulation in sugar factory installations. K. SEIFFERT. *Zucker*, 1959, **12,** 349–355.—The economics of heat insulation are discussed, especially in the case of a Raabe "Rapid" diffuser and a drum drier. The question of monetary losses due to heat losses on the one hand, and amortisation on the other, as well as insulation thickness in relation to temperature, are dealt with and graphs and tables are presented. It is shown that a dryer drum 3·2 m in dia. and 14 m long can be so insulated as to provide a saving of 70 tons of coal in one campaign.

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Sedimentation of turbid material in carbonatation. A. R. GIONA and E. MARIANI. *Ind. Sacc. Ital.*, 1959, **52,** 272–281.—Experiment shows that the settling rate in carbonatation juices follows the classical relationships as well as conforming to the formula of C. ROBINSON[2].

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Study of the microflora in a rotary diffuser. V. S. KURBATOVA. *Sakhar. Prom.*, 1959, (7), 16–21.—Tables are given of the losses in sugar during 24 hours at initial temperatures of 36 and 60°C with a population of bacteria of various groups of 30 million/ml of medium. At a temperature of 70–72°C diffusion may be carried out under almost sterile conditions. After spontaneous fermentation for 12 hr the pH and sugar content of diffusion juice had remained

[1] See *I.S.J.*, 1954, **56,** 277; 1956, **58,** 345.
[2] *Ind. Eng. Chem.*, 1926, **18,** 869–971.

constant. A graph of pH in a rotary diffuser shows the lowest pH in cells 8–11, corresponding to the lowest temperature. Two curves are drawn, one for pH at normal diffusion temperature (65–68°C) and one at 52–68°C. The bacterial population with normal diffusion conditions was 10–12 million/ml juice, compared with 60–70 million/ml juice at the low temperature. Pre-scalding of cossettes at lower than 90°C results in a cossette-juice mixture containing many live bacteria. Stoppages also cause an increase in bacterial population. Doses of 7–10 litres of formalin (0·005–0·01% on beet) added every 2 hr in the 17th cell of the diffuser caused a check to the increase in acidity after 15–20 min and the pH curve levelled out to its normal shape. The pH in the 5th, 13th and 18th cells was determined before formalin addition and at certain periods after, and results are tabulated and presented in graph form.

* * *

Certain causes of deterioration in the quality of yellow sugars. D. V. GORBAN'. *Sakhar. Prom.*, 1959, (7) 22–24.—To raise the purity of final product yellow sugar from 94–94·9 to about 96, the following recommendations are made : increasing the pan capacity; introducing extra heating elements or special circulating devices; increasing the number of crystallizers; and affining with green syrup. Attention should be paid also to the entry of cold air into the centrifugal basket, which increases the viscosity of the molasses film on the sugar crystals, the increase being greater the larger the temperature difference between the massecuite and the air. Covering the top of the basket is recommended.

* * *

The suggestion of V. N. Peletminskii on modernization of carbonatation juice clarifiers. I. G. CHUGUNOV. *Sakhar. Prom.*, 1959, (7), 24–25.—The proposals of V. N. PELETMINSKII[1] on modifications to carbonatation juice settlers are criticized on the grounds that the effective radius of the juice withdrawal pipe is not merely a function of the juice compartment height, but is primarily a function of the amount of clear juice withdrawn per unit time. Increasing the number of juice discharge ports and reducing the height of the juice compartments will have the desired effect with parallel mud and juice discharge, thus reducing the retention time and increasing the throughput. The work of Peletminskii is considered very useful and should be used as a guide in design work on juice withdrawal.

* * *

Nomogram for calculation of juice feed pipes. V. I. CHOPIK. *Sakhar. Prom.*, 1959, (7), 27–28.—A nomogram is presented, based on the formula

$$D = \sqrt{\frac{4\,Aa}{3{\cdot}14 \times 1440 \times 60\,v\gamma}}$$

where D = dia. of juice pipe in m, A = daily beet slicing in centners, a = amount of product % weight of beet, v = flow rate in m/sec, and γ = density in kg/sq.m.

Obtaining a dry pectin adhesive from pulp by the KTIPP method. I. M. LITVAK and M. I. BARABANOV, *Sakhar Prom.*, 1959, (7), 28–33.—See *I.S.J.*, 1959, **61**, 153.

* * *

A method of relieving molasses pump gears. P. S. MAKSIMUK. *Sakhar. Prom.* 1959, (7), 33–34.—The relatively low efficiency of a geared molasses pump (η = 0·6–0·7) results from the considerable pressure build-up in the tooth spaces on expulsion of the fluid. Where the teeth fit tightly into the space, the fluid is expelled through very small gaps. The pressure creates resistance to the rotation of the gears and high radial loading. Further resistance to rotation also occurs when the teeth are disengaged, as the vacuum arising in the space formerly occupied by the tooth cannot be filled by the fluid. The bushes of the bearings quickly wear out as a result of the terrific thrust, and the gears of the intermediate transmission have a short life because of the resistance to rotation. At Kupyansk factory the gears were relieved by cutting a discharge channel on one side of the gear above, and a suction channel on the other side and below, the gear axle. The power requirements were cut by 1·5–2 kW and the pumps operated a whole campaign without trouble.

* * *

Modernization of the condensate (removal) scheme at Odessa refinery. V. YA. BRAGINSKII. *Sakhar. Prom.*, 1959, (7), 38–40.—In the modified condensate removal system at Odessa the condensate from the pans and ejectors passes direct to a central accumulator, in which the pressure is about the same as that of the heating steam. From steam ejectors located below the level of the main accumulator condensate passes direct to an evaporator-accumulator, to which is also fed condensate from the main accumulator. Condensate is pumped from the evaporator-accumulator to the boilers, while sweet-condensate from the pans passes via a secondary evaporator-accumulator to the hot water accumulators. Vapour is bled from the main accumulator to process and from the evaporator-accumulator to the hot water accumulator. Three steam-traps (before the sweet-condensate evaporator-accumulator, between the low-level ejectors and the evaporator-accumulator and between the latter and the main accumulator) are installed instead of a previous 26, while the number and length of the condensate lines has been somewhat reduced. Heat losses have been reduced as well as maintenance cost.

* * *

The effect of beet health on its storage properties. M. DRACHOVSKÁ. *Listy Cukr.*, 1959, **75**, 177–180.—A review as above, with mention of microbiological tests. Tests during 1951–57 with various chemicals have shown that the daily losses are reduced by treating stored beet with V–K chalk and tetrachloronitrobenzene (both 0·3% on beet), while losses in beet treated with 2–6 Bé milk-of-lime remained the same as in the control pile. Addition of carbonatation mud, lime dust, and milk-of-lime with earth or mat protection had no inhibiting effect.

[1] *I.S.J.*, 1959, **61**, 372.

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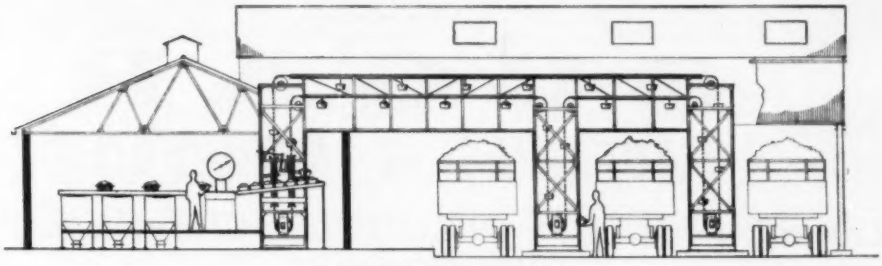

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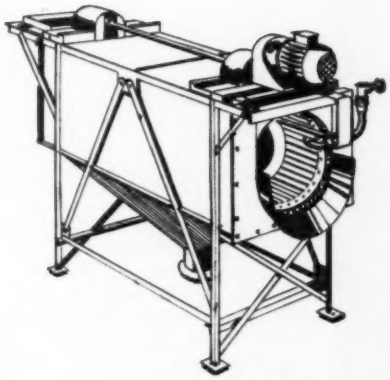

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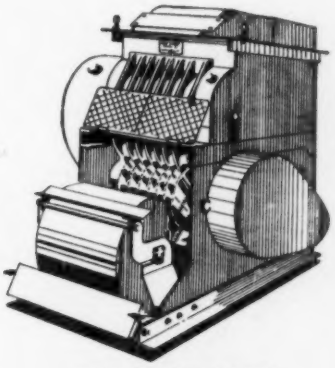

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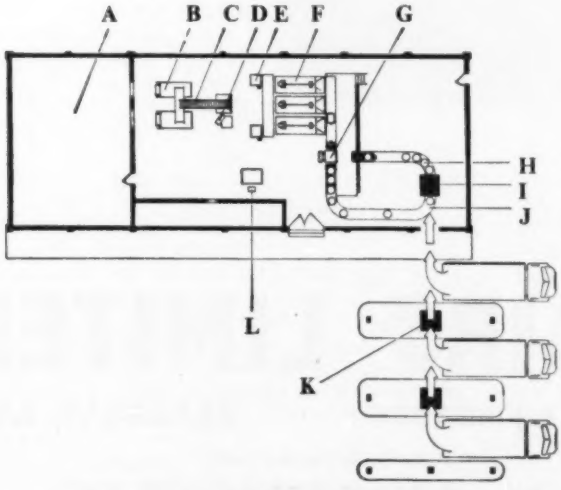

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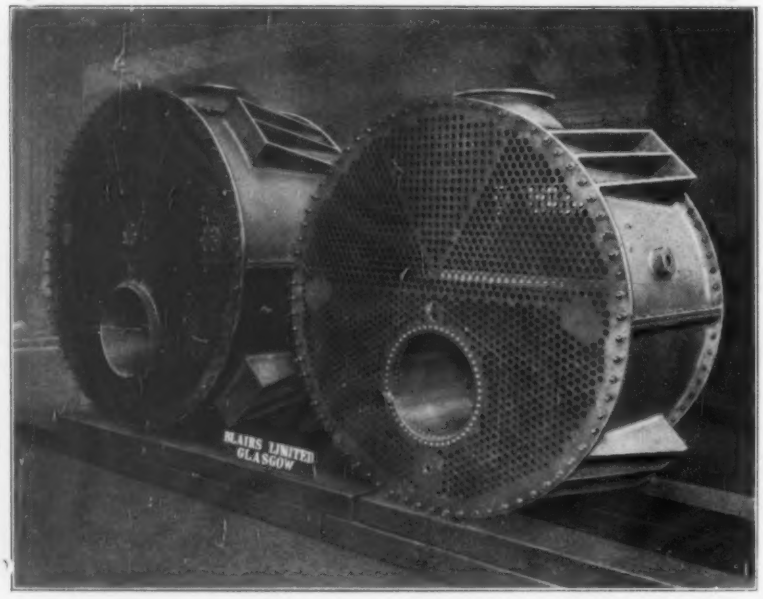

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New Books and Bulletins

Proceedings of the Fifth Technical Session on Bone Char, 1957. Ed. V. R. DEITZ. 336 pp; 8 × 10½ in. (Bone Char Research Project Inc., National Bureau of Standards, Washington, D.C., U.S.A.) 1959.

This volume records the 1957 Session which was held at the National Bureau of Standards, with 73 delegates attending. It gives a list of industrial sponsors and cantains a tribute to the late F. J. BATES, one of the founders of the Bone Char Research Project. After introductory remarks by A. V. Astin, the texts of the eighteen papers presented are given together with the discussions they provoked. The book closes with a list of abbreviations and a number of conversion tables. The name index indicates where the person concerned is mentioned in a reference or is the author of a paper or took part in the discussion, while the Proceedings close with a useful subjects index which also indicates where the subject was mentioned in the text, discussion or in a reference.

* * *

Sugar Cane Varieties in Barbados. G. C. STEVENSON. 25 pp; 6½ × 9½ in. (B.W.I. Central Cane Breeding Station, Barbados, W.I.) 1958.

This Bulletin, No. 39, is a review of the varieties grown in Barbados from 1640, when sugar was manufactured there, to the present day. This varietal history falls into three periods; the first is that of importation—first the Creole, followed by Bourbon, Cheribon and a host of others. This lasted until 1888 when PARRIS' discovery that the cane set viable seed (1858) received recognition, and a period of inter-crossing of noble canes followed. Thereafter came the third period (1925 to date) which may be termed the "nobilization" period. The Bulletin ends with brief notes on commercial varietal trends, inbreeding and cytogenetics.

* * *

Food Directory 1959–1960. Ed. R. DE GIACOMI 845 pp., 5¼ × 8¼ in. (Tothill Press Ltd., Tothill Street, Westminster, London, S.W.1.) 1959. Price : 40s. 0d.

The structure of the fourth edition of "Food Directory" remains as before. The main sections are Food Manufacturers, Commodities, Plant and Equipment, Packaging Materials, Brand Names, Food Laws. The first four are divided into two parts, one giving the names, addresses, and telephone numbers, and the second a classified list of the materials or products.

The Food Manufacturers section reflects the changes in pattern within the industry which have occurred since the last edition through the regrouping and amalgamations which have very often involved quite large companies.

The section summarizing food standards and regulations throughout the world, including those of the U.K., has again been prepared by C. L. HINTON, F.R.I.C. The addition of summaries for six countries not previously included brings the total up to 57. The recent alterations made in various countries in the permitted lists of colouring matters are shown in the Table of Official Permitted Colours. Other sections of the Directory give information about Government departments, food research organizations, trade associations, schools and colleges with full time specialized courses in food technology, and a list of consultants.

* * *

The Situation of the Sugar Economies of the E.E.C. and other Countries of Western Europe. H. AHLFELD. 72 pp.; 8¼ × 11¾ in. (F. O. Licht K.G., P.O. Box 90, Ratzeburg, Schleswig-Holstein, Germany.) 1959.

The present in Licht's series of monographs follows the previous models in being in two languages—left- and right-hand columns of each page—but this time is in German and French instead of German and English. It is in six parts, the last being an assembly of statistical data on the beet and sugar crops of the members of the E.E.C. and other West European states.

The titles of the first five parts are, respectively, "The significance of the Economic Community in its revolutionary economic development"; "The situation of the sugar economies of the European Economic Community"; "The possibilities for the sugar economy inside the E.E.C."; "Thoughts on the aspect and evolution of the sugar economy in the E.E.C. zone"; and "The sugar economies of the West European countries". In the first, the enormous task of forging a unity from the six individual countries and some of the attendant difficulties are discussed, a parallel being drawn with the formation of the German Customs Union in 1838. In the second, a brief history is given of the sugar economies of the "Six" and also of Turkey and Greece. Consumption and production figures for the E.E.C. are discussed in the third part, with thoughts on the development of the industry. Various aspects—beet cultivation, sugar production and distributions, exchange of technical research results and common advertising are discussed in the next part, which also emphasizes that many problems have not yet appeared. The final part of the text considers the changes in sugar and beet statistics for 1951/52 and 1957/58, while the relations between the E.E.C. and, particularly, the Free Trade Area economies are discussed, with a short passage on the development of links between the two bodies.

Laboratory Methods and Chemical Reports

Determination of molasses in molasses fodder. K. CÍHAL and L. SCHMIDT. *Listy Cukr.*, 1959, **75,** 158–161.—Comparative tests were made on determination of molasses in fodder. Molasses is extracted with water and determined conductimetrically or polarimetrically; both methods are accurate to ±1%.

* * *

Studies on the formation of molasses. I. Evidence for the formation of sugar-salt complexes. N. A. RAMAIAH and –. VISHNU. *Sharkara*, 1959, **2,** 3–18.—The application of Job's principle[1] to the polarimetric examination of sugar-salt solutions indicates that both sucrose and levulose form monomolecular complexes with LiCl, KCl, KBr, KI, NaCl, NaBr and NaI, while complexes are formed between one and two mols sucrose and one mol of $MgSO_4$, Ca acetate, and $BaCl_2$. No complex was found between sucrose and $Pb(NO_3)_2$, while levulose formed two complexes containing 1 and 2 mols of sugar per mol of salt. Sucrose was inverted in the presence of $AlCl_3$ and $Fe_2(SO_4)_3$, while levulose formed complexes containing 2 mols per mol of these salts.

* * *

Presence and determination of insoluble impurities in raw sugar. J. B. ALEXANDER and K. DOUWES DEKKER. *S. African Sugar J.*, 1959, **43,** 607–613.—The results of the investigation by HONIG & ROOSEBOOM[2] are discussed and a similar centrifugation technique recommended for examination of Natal raws. In this a 50°Bx solution of the sugar is strained through a small 80-mesh horizontal sieve and 100 ml placed in a Goetz or oil tube calibrated at the bottom at 0·01 ml intervals up to 0·20 ml. The tube contents are then spun in an International Size I Type S.B centrifuge for 15 min at 1500 r.p.m., the tip of the tube being 8 in from the centre of the centrifuge. The apparent volume of the phase separated out is a measure of the insolubles content of the sugar.

* * *

Application of the AZP (Carl Zeiss 0·05°S automatic polarimeter) in the sugar industry. I. BECKER. *Zucker*, 1959, **12,** 356–357.—The new Zeiss automatic polarimeter (the basic principles of which have been described earlier[3]) is discussed. The flow tube, taking the place of the conventional polarimeter tube, is heated for 5 min before the start of determinations, the null point first being established by rinsing the flow tube with dilute acetic acid (3%) and this followed by distilled water until neutral. The results with a 100 mm tube must be doubled to correspond to those given with a 400 mm visual polarimeter tube. Comparison with the results using the automatic and a visual polarimeter gave a ±0·05°S difference, although it is not known which instrument was the more accurate. The sugar content of slightly turbid solutions can be measured to an accuracy of ±0·1°S and the instrument can handle very dark and turbid solutions. Ten analyses can be made in 5 min, maintenance of a constant temperature being necessary, as a difference of 7°C causes a 1·0°S error in determinations.

* * *

Determination of sucrose solubility. W. S. WISE. *Sugar J.* (La.), 1959, **22,** (2), 26–32.—A description is given of the DAUNCEY & STILL technique[4] for determination of sucrose solubility as used to find the effect of third components.

* * *

Analytical characterization of the purest and commercial sugar. G. MANTOVANI. *Ind. Sacc. Ital.*, 1959. **52,** 282–293.—The characteristics of commercial and pure sugar are briefly surveyed and analytical control discussed. Points mentioned include reflectance[5], ash determination, spectrophotometric examination, and detection of sugars. Inorganic constituents determination by radio-isotopes and colorimetry are reviewed, while chromotographic elution, electrophoresis and gas chromatography for estimation of raffinose and amino-acids are described. Other subjects reviewed are the determination of reducing sugars in refined sugars.

* * *

Glutamine, glutamic acid and its anhydride. G. NOTO LA DIEGA. *Ind. Sacc. Ital.*, 1959, **52,** 294–301.—By estimation of amino-nitrogen by the method of POPE and STEVENS[6] and of amino-nitrogen by that of VICKERY and PUCHER[7] a series of graphs were prepared indicating the equilibrium of the reaction pyrrolidone carboxylic acid + water ⇌ glutamic acid, for pH values between 3 and 13, at 80°C. Determinations of glutamine and its two acids in beet, raw juice, thin juice, thick juice, molasses and Steffen or saccharate mother liquor, have also been made, and the changes in the relative proportions related with the pH of the particular stage of processing.

[1] *Compt. rend.* 1925, **180,** 928; *Annalen*, 1928, **9,** 1133; 1936, **6,** 97.
[2] *Verhandel. Leden. Proefsta. Java-Suikerind.*, 1933, (4).
[3] *I.S.J.*, 1959, **61,** 91.
[4] *J. Applied Chem.*, 1952, **2,** 399.
[5] See *I.S.J.*, 1958, **60,** 44–46.
[6] *Biochem J.*, 1930, **33,** 1070.
[7] *Ind. Eng. Chem. (Anal. Ed.)*, 1940, **12,** 27.

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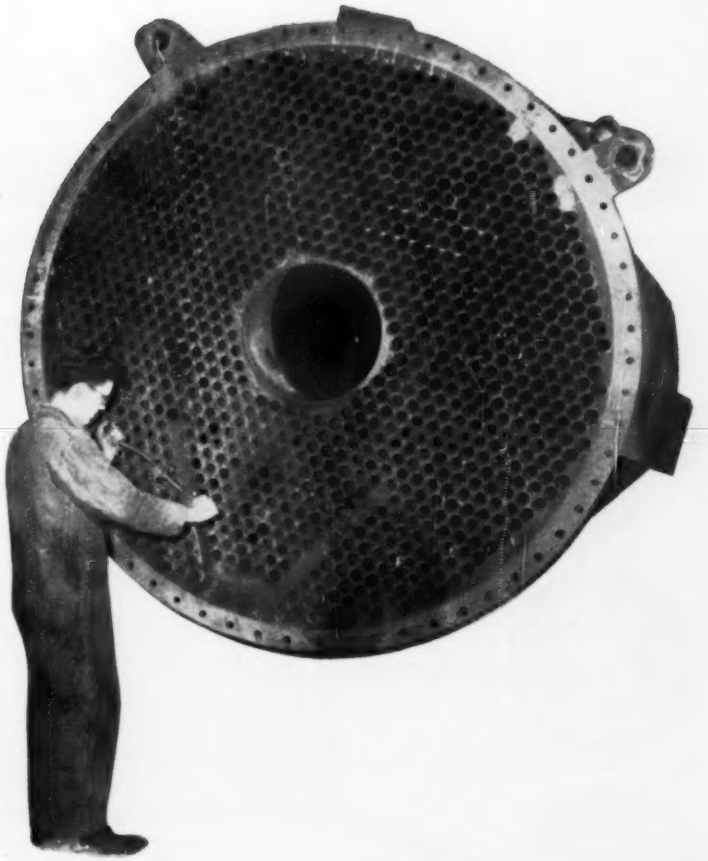

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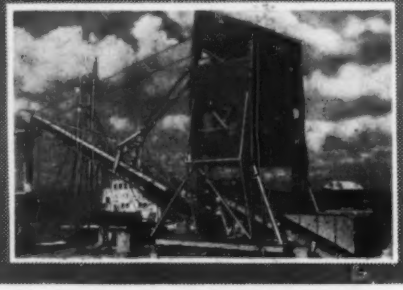
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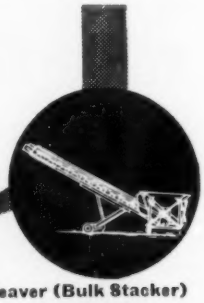
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UNITED KINGDOM

Glutamic acid from residual liquid from sugar containing juices. N. V. CENTRALE SUIKER MIJ., of Amsterdam, Netherlands. **817,178.** 13th August 1956; 29th July 1959.—A sugar solution from which most of the sugar has been removed, e.g. Steffens' waste, vinasse, etc., is concentrated, mixed with 2–15% of alkaline earth hydroxide and heated for 10–15 minutes at a temperature of 80–110°C and after cooling is diluted with 1–3 parts by weight of an organic polar liquid (e.g. methanol) or a mixture of liquids, diluted if necessary with water, and solids separated. The organic liquid is removed by evaporation and the remaining liquid concentrated to a specific gravity of 1·2–1·4. The pyrrolidone carboxylic acid content is hydrolysed in an alkaline or acid medium (with HCl) and after concentration (with as much of the NaCl removed as possible) the glutamic acid is precipitated by adjusting the pH to the isoelectric point.

* * *

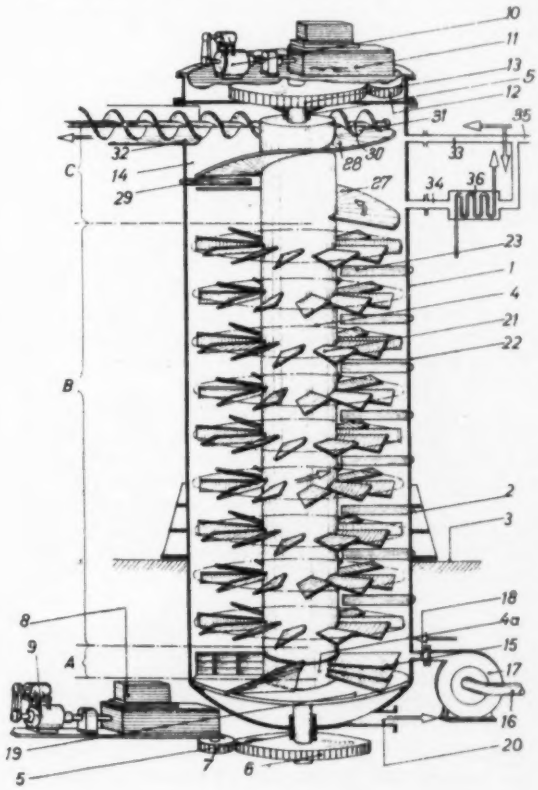
Glutamic acid from vinasse. N. V. CENTRALE SUIKER MIJ., of Amsterdam, Netherlands. **817,179.** 4th February 1957; 29th July 1959.—Vinasse is diluted with 1–3 parts by weight of water, treated with 2–15% alkaline earth hydroxide and heated at 50–100°C for a time sufficiently short that no pyrrolidone carboxylic acid present is hydrolysed. Solids are separated and the pyrrolidone carboxylic acid then hydrolysed and the glutamic acid separated (e.g. as in the preceding patent).

* * *

Extracting liquid (juice) from fibrous material (sugar cane). E. OMAN, of Stocksund, Sweden. **820,735.** 26th July 1956; 23rd September 1959.—Sugar extraction is carried out in at least two consecutive squeezing stages. In the first stage the cane passes through mills providing 1–3 (2) high-pressure squeezes; it then passes through the second stage of 4–10 (5–8) squeezes at a lower pressure sufficient to reduce the water content to 55–80% (60–65%) after each squeeze, washing being carried out during this stage. The bagasse can then be carried to a third stage where higher-pressure mills reduce the water content, the juice expressed being returned to the second, washing stage.

* * *

Apparatus for extracting sugar (Beet diffuser). BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **820,650.** 30th November 1956; 23rd September 1959.—In the beet diffuser shown, cossettes mixed with juice are pumped into the tower 1 through pipe 18 and are distributed around shaft 4 and above screen 19 by the blades 15 which also raise the cossettes from the stirring zone A into the extraction zone B. The bottom part 4a of shaft 4 is



driven by motor 9 through gearing 6, 7, 8 while the upper part is driven by motor 10 through gearing 11, 12, 13. The shaft 4 carries sets of fixed vanes 21 inclined so as to raise the cossettes and interrupted by retarder plates 23 which may be adjusted so as to change their aspect relative to the flow of cossettes. After passing up the extraction zone, the exhausted cossettes reach the discharge zone C where they are carried by scroll elements 27, 28 and transferred to the screw discharger 31 and out through pipe 32. Water enters the tower through pipes 33, 34, the latter embodying a heater 36, and passes down the tower, becoming richer in sugar, until it passes as juice through screen 19 and out by pipe 20.

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Magnetic "Boxmag" Separators in the Sugar Industry. Electromagnets Ltd., Boxmag Works, Bond St., Hockley, Birmingham 19.

Cane mill protection.—The most efficient type of "Boxmag" separator is the super-intensity magnetic conveyor head which is built into a short-centred conveyor fitted in the base of the chute between the cane carrier and crushing rolls. This type of separator produces a deep impinging magnetic field and is capable of automatically removing tramp metal from the cane and discharging into a suitable collecting chamber outside the cane chute. Tramp iron extracted during a campaign at Riche-en-Eau estate in Mauritius totalled 537 lb, including chains, shackles, nuts, bolts, knives, hooks, etc. A second type of equipment is the "Boxmag" superflux magnetic chute separator Type DXS which is a static unit in the cane chute base and has a similar function but collects the tramp metal for manual removal at the end of crop. This type suffers from the disadvantage that, if a large piece of tramp metal is caught it might cause entanglement of the cane and subsequent bridging of the chute which could cause dislodgement of the metal.

Raw sugar intake.—Various types of magnetic separators, generally the suspension, magnetic pulley and overband types, can be mounted across or in line with a raw sugar intake conveyor at a refinery to remove such pieces as nuts and bolts, fitters' tools and even hand rails which have fallen into the ship's hold after dockside damage. The most suitable type of equipment must be chosen on the merits of the particular application.

Sugar beet intakes.—Suspension or overband type separators are usually those suitable for mounting over beet intake chutes for removal of pieces of farm implements, etc. which might otherwise damage the beet knives.

Refined sugar purification.—By the time refined sugar has reached the bagging or packaging department it has sometimes become contaminated with magnetic scale or oxide which has formed in the plant. This material is only feebly magnetic, and a very strong magnetic field is required for its elimination. This is provided by a special version of the superflux Type DXS separator, located at the discharge point of the elevator feeding the bagging hoppers or packeting plant. The sugar is discharged in a steady stream about 1 inch deep over the separator surface.

Dried beet pulp.—If separation is not effected at the beet intake it is possible that tramp metal will pass through the plant and emerge in the dried pulp so affecting its value as animal fodder. Consequently it is advisable to install a magnetic conveyor head in the discharge from the dryers before bagging.

PUBLICATIONS RECEIVED

VACUUM BOILING PANS. Maschinenfabrik Buckau R. Wolf A.G., Grevenbroich-Neuss, Germany.

The vacuum pans described in leaflet F 1218 are economical, reliable in operation and are easy to control. Details of their design and manufacture are discussed and illustrated.

* * *

CROFTS RADIATION COMBINED SPUR AND WORM DOUBLE REDUCTION GEAR UNITS. Crofts (Engineers) Ltd., Thornbury, Bradford 3, Yorkshire.

Publication No. 758 contains illustrations and data of size, output and input speeds, loads and input and output h.p. for this wide range of gear units which are available in a number of mountings, with powers up to 60 h.p. and ratios from 300 to 30:1.

* * *

RICHARDSON ROTARY PADDLE FEEDER. Richardson Scale Co. Inc., Van Houten Ave., Clifton, N.J., U.S.A.

Product Data Sheet No. 5901 contains information on special features of a new "rotary paddle feeder" designed to assure even, uninterrupted flow of ground and small-size granular materials; these include in-line bin feed and discharge which permits installation directly below a bin, spout or storage hopper.

* * *

HAULAGE MACHINES. Link-Belt Company, Prudential Plaza, Chicago, Ill., U.S.A.

Book 2892 contains descriptions, engineering data and 14 typical layouts that illustrate the many types of applications to which Link-Belt capstan car spotters and drum-type car pullers can be adapted. Most commonly used for moving rail cars these machines are also successfully employed in handling a wide range of mobile loads, from warping barges along a dock to pulling cars of castings into and out of annealing furnaces.

* * *

POWERGRIP PRODUCTS. William Kenyon & Sons Ltd., Dukinfield, Cheshire.

The PowerGrip belt, developed by the U.S. Rubber Corp., consists of steel cable tension members, backed with neoprene and fitted with neoprene teeth, the whole faced with nylon. The belt gives a positive non-slip drive of high efficiency at all speeds, and with a wide range of applications. Some of these applications, advantages, and other data are illustrated and described in a new booklet issued by the U.K. distributors above.

* * *

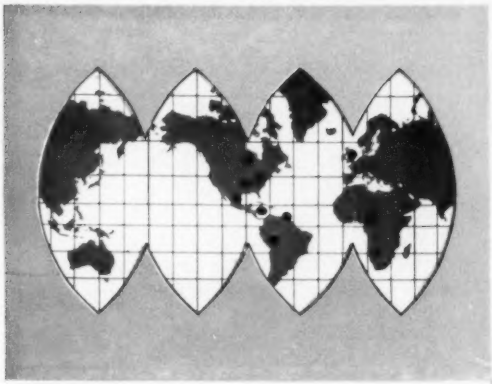
IT'S NOT AN ACCIDENT. Honeywell Controls Ltd., Ruislip Road East, Greenford, Middx.

A new publication explains why "It's not an accident . . . when the quality of your product leads the field", the field in this case being millivoltmeters, and the cause being attention to details—of customers' needs, design and construction and of service.

* * *

MIRRLEES CHOKELESS PUMP UNSTRAINED JUICE RETURN SYSTEM. The Mirrlees Watson Co. Ltd., 45 Scotland St., Glasgow, Scotland.

Leaflet S.337 describes and illustrates the compound imbibition process in which Mirrlees chokeless centrifugal pumps are used to return juice to earlier mills, the crusher and first mill juice passing through a Peck strainer before passing to process. An inclined distributing plate discharging against a hinged baffle is used for even spreading of the juice-bagacillo mixture at the mills with an adjustable counterweight on the baffle to govern the flow rate. The centrifugal pumps are fitted with an air bleed on their suction side to control their throughput. A duty table gives the capacities and speeds of various sizes of pump against a number of heads.



Refineries the world-over find FAS-FLO* FILTERS more profitable!

Throughout sugar-producing areas, refineries report increased production, higher recovery, ease of operation and maintenance and a minimum of down-time with unique FAS-FLO FILTERS.

These important advantages of our horizontal-leaf design tell you why:

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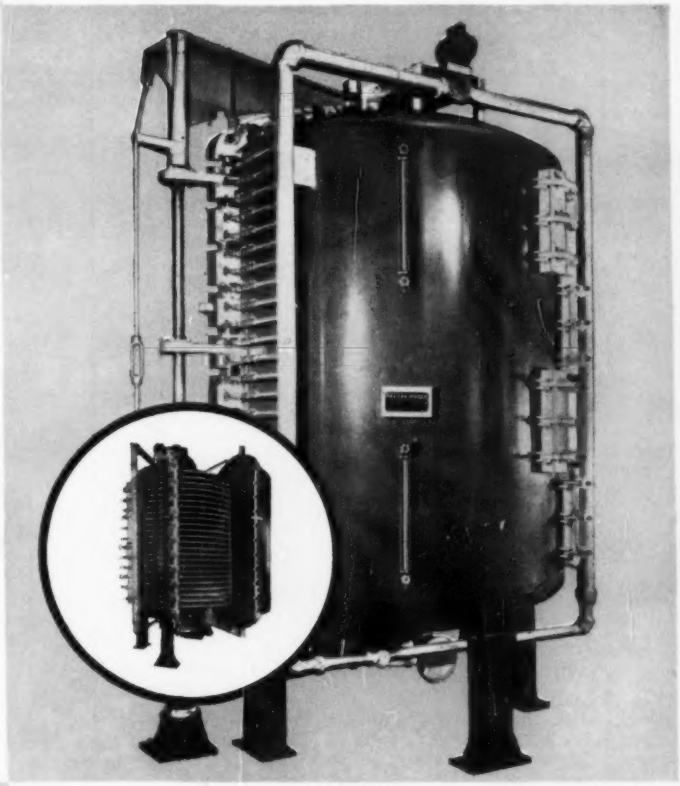
- **no interruptions due to cake falling off!**
- **no "blinding" of filter cloths!**
- **time-saving 7-minute sluicing cycle with high-pressure jets!**
- **filter remains closed during sluicing!**
- **separate outlet, shut-off cock and sight glass for each leaf!**
- **filter cloths last four to six months — require no sewing!**
- **most easily automated filter made!**

We will gladly discuss the added profit potential you might realize with FAS-FLO FILTERS.

*Reg. TM of FAS-FLO FILTER CORPORATION, New York



552 sq. ft. split shell model. This model can be made in any size desired. Inset is rear view with door open showing horizontal leaves.

Most efficient carbon you can use!

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ACTIVATED CARBON

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SUCHAR SALES CORPORATION

CONSULTING ENGINEERS

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Cable Address: "SUCHARING" N.Y.

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THE

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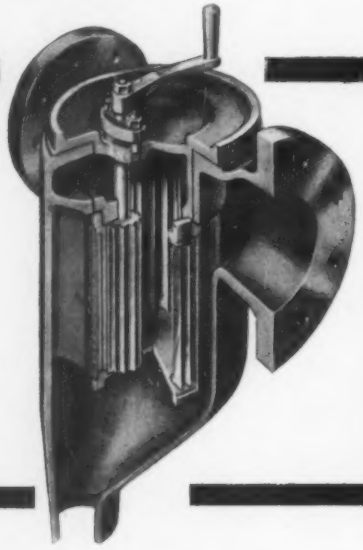
SELF-CLEANING STRAINER FOR ALL SUGAR LIQUORS



With the ROTOKLENE self-cleaning strainer liquors can be efficiently strained to fine limits. A simple, unique and reliable cleaning mechanism allows the strainer to be cleaned without interruption of flow by a few turns of a handle. Where constant cleaning is necessary, the strainer can be belt or motor driven. There are few moving parts, all robustly constructed to ensure long life.

Write for an explanatory booklet and details of installations where ROTOKLENE strainers are being used with outstanding success for straining clarified cane juice and similar applications in the Sugar Industry

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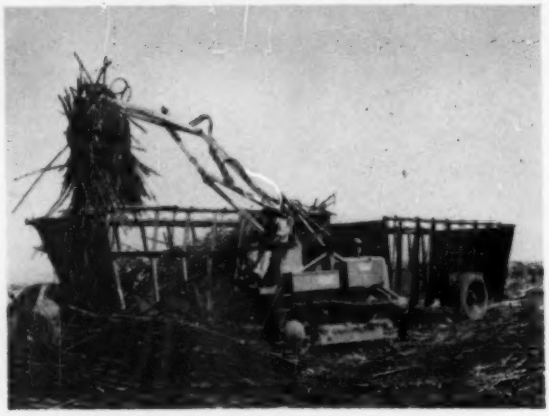

Broussard patented "flex-boom" loader mounted on Track-Marshall crawler tractor, with push piler, in Rhodesia.

Capacity 200 lb minute (under Louisiana conditions), grab capacity (54 in. opening) 1500 lb., load clearance 12 ft. 11 in., loading radius 10 ft. to 12 ft. boom swing front to right, 100°.

The Broussard heavy duty tropical type loader is now available for installation on the Caterpillar D4, International TD-6, John Deere 440 crawler, Fordson-Major and various U.S.A. wheel Tractors.

Extremely simple in design with few wearing parts, the Broussard loader may be easily installed at the destination on tractors already in hand and quickly removed from the tractor at the close of the harvest.

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BROUSSARD MACHINE COMPANY

ST. MARTINVILLE, LOUISIANA

Export Division

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WESTWOODS

Peru Sugar Exports, 1956-1958[1]

(In long tons, tel quel)

Destination:	1958	1957	1956
EUROPE:			
Belgium	295	9,856	958
France	—	7,389	—
Germany	5,562	27,849	5,139
Holland	2,264	4,386	689
Ireland	—	—	10,386
Italy	494	494	692
Switzerland	—	1,333	5,389
United Kingdom	48,577	51,459	42,854
Yugoslavia	—	10,036	—
Total Europe	57,192	112,802	66,107
AMERICAS:			
Bolivia	31,210	36,169	41,693
Chile	166,133	112,339	155,322
Costa Rica	—	—	2,241
Honduras	789	494	—
Paraguay	—	—	5,905
United States	75,899	78,612	46,927
Uruguay	—	29,544	15,250
Total Americas	274,031	257,158	267,338
ASIA:			
Ceylon	9,747	—	11,894
Japan	37,162	117,951	76,198
Korea	6,693	497	—
Syria	9,842	—	—
Thailand	15	—	—
Total Asia	63,459	118,448	88,092
OTHERS:			
French Morocco	9,515	—	—
Total Others	9,515	—	—
TOTAL EXPORTS	404,197	488,408	421,537

Corrigendum. On page 290 of our October 1959 issue, the cost of Redpath refinery was given as an estimated $1·4 million. This should have read $14·4 million.

* * *

New sugar factories for France[2].—Agricultural and beet-growing circles are considering the possibility of a sugar factory in the south-west of Deux-Sèvres, near Forges d'Aunis. At a meeting of the Chamber of Commerce of Chateauroux, beet planters have also considered the construction of a sugar factory in the neighbourhood of Montierchaume in Champagne Berrichonne.

* * *

Sugar factory for Ghana[3].—A sugar factory is to be constructed in Ghana by a West German company. It will have an annual production of 10–13,000 tons of white sugar, that is a sixth of Ghana's sugar consumption.

* * *

Seed cane planter in Hawaii[4].—A new seed cane planter has been developed by Hawaiian Commercial & Sugar Co. at Puunene to perform three functions at the same time. It furrows, plants and fertilizes the seed cane with aqueous ammonia from two 140-gallon tanks mounted on the planter. At the lowest fertilization rate the tanks carry enough for four acres while at the highest rate the planter will cover two acres.

* * *

Nepal sugar factory plans[5].—The U.S.S.R. has recently granted a credit of 35 million roubles to the Nepal Government which will permit construction of a sugar factory in that country.

BREVITIES

Cane diffusion experiments in Hawaii[6].—Since March 11th 1959 the experimental cane diffuser at Kekaha has been running at intervals, about 13,000 tons of cane having passed through it. The diffuser averaged 95% extraction at an average rate of 17 tons per hour, while throughputs of 20 tons per hour have been achieved for short periods. A dewatering screw press was added to the unit[7] but while extraction went as high as 98·8% and averaged 97·8%, the capacity was reduced to 10½ tons per hour. A projected change is to increase the capacity of the unit by internal changes, and also modification of the discharge mechanism and chopped cane feed.

* * *

U.S. beet factory closed[8].—Holly Sugar Corporation has sold its factory and property at Swink, Colorado, for dismantling and disposal. The factory did not operate during the last crop. Holly Sugar Corp. also sold their Garden City factory, Kansas, after closing it in 1957.

* * *

Brazil sugar production 1958/59[9].—Sugar production in 1958/59 increased to 3,545,596 short tons, 21·1% higher than in the previous season and an all-time record. Consumption was 14·1% higher at 2,522,916 tons, and exports 12·7% higher at 834,331 tons. Stocks rose by 47·0% to 586,893 tons. The Instituto do Açúcar e do Álcool believe that, in view of the rapid expansion of the industry, production will exceed domestic requirements plus export possibilities in 1959/60 and may well reach 3,960,000 tons unless restricted. The Minister of Finance has agreed to buy and store the excess in order to stabilize prices.

* * *

Sugar factory project for Argentina[10].—Technical experts of CEKOP, the Polish concern specialising in the construction of sugar factories, are visiting the province of Chaco with a view to studying the possibility of building a factory there, a project in which the local concern Cooperativa de Cañeros El Zapallar Ltda. is stated to be interested. The factory would have a daily capacity of 3000 tons of cane and 24,000 litres of alcohol and would cost in all a total of around 800 million pesos. The cost of the imported Polish equipment alone is estimated at U.S. $5,400,000, payable 35% in cash and the balance in five annual instalment with interest at 6% per annum. The Press reports that another sugar cooperative in Santa Fe has already decided to acquire a similar factory from the Polish firm.

* * *

New refinery for El Salvador[11].—The sugar refinery of the Cooperativa Azucarera de El Salvador was scheduled to begin production during the second half of October with an estimated daily production of 3000 quintals (about 300 short tons). An official of the Cooperative stated that the decision to instal a sugar refinery was taken because of the country's increased sugar consumption during the last few years; this year's consumption is expected to reach 850,000 quintals (about 85,000 short tons).

* * *

New sugar factory for Japan[12].—Plans have been completed for the construction of a 1200-ton beet sugar factory by the Hokuren Co. of Sapporo, Hokkaido. It will cost $5,560,000 and provision is to be made for subsequent expansion to a slicing capacity of 1600 tons per day.

[1] *Lamborn*, 1959, **37**, 206.
[2] *Bull. C.E.D.U.S.*, 1959, (5), 17.
[3] *Bull. C.E.D.U.S.*, 1959, (5), 18.
[4] *Sugar y Azúcar*, 1959, **54**, (11), 64.
[5] *Bull. C.E.D.U.S.*, 1959, (5), 18.
[6] *Sugar News* (Hawaii), 1959, **9**, (9), 4.
[7] *I.S.J.*, 1959, **61**, 383.
[8] *Sugar y Azúcar*, 1959, **54**, (11), 65.
[9] *Sugar y Azúcar*, 1959, **54**, (11), 65.
[10] *Fortnightly Review*, (Bank of London & South America Ltd.), 24th October, 1959.
[11] *Fortnightly Review* (Bank of London & South America Ltd.), 7th November 1959.
[12] *Sugar y Azúcar*, 1959, **54**, (11), 68.

BREVITIES

Sugar packeting in Southern Rhodesia.[1]—A new automatic packeting machine which packs sugar in 4 lb packets at the rate of 20 tons a day has been brought into commission by the Rhodesian Sugar Refinery Ltd. factory in Bulawayo. The machine is the first of this size to be put into service anywhere in the world. The sugar will cost retailers 1d. extra for each 4 lb but the saving in labour and wastage in spilling is expected to recompense them for the increased cost.

* * *

British sugar beet equipment for Russia[2].—Vickers and Bookers have secured a contract involving sugar beet unit equipment to be supplied to Russia. The value of the contract is more than £500,000 the company says. Vickers and Bookers is a joint company formed by Vickers-Armstrong (Engineers) and Bookers Engineering Holdings for developing sales and the supply of machinery for sugar beet factories to the U.S.S.R., China, and other eastern European countries.

* * *

European beet sugar production estimates[3].—Licht's third estimates of the current European beet sugar crops now total 17,006,900 compared with the previous estimate[4] of 17,098,000 tons. Small adjustments have been made to most estimates while major changes are those for West Germany (down 85,000 tons); East Germany (down 70,000 tons), Austria (up 20,000 tons), Poland (down 30,000 tons), Italy (up 46,000 tons), Roumania (up 25,000 tons) U.K. (down 25,000 tons), and Turkey (up 30,000 tons). Albania appears in the new estimates with a production of 13,000 tons.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 17th December*, 1959)

Anglo-Ceylon (5s)	19/3
Antigua Sugar Factory (£1)	18/–
Booker Bros. (10s)	29/3
British Sugar Corp. Ltd. (£1)	25/6
Caroni Ord. (2s)	4/6
Caroni 6% Cum. Pref. (£1)	19/6
Distillers Co. Ltd. (6s. 8d. units)	36/9
Gledhow Chaka's Kraal (£1)	61/3
Hulett & Sons (£1)	75/–
Jamaica Sugar Estates Ltd. (5s units)	9/6
Leach's Argentine (10s units)	15/3
Reynolds Bros. (£1)	60/–
St. Kitts (London) Ltd. (£1)	67/6
Ste. Madeleine (Ord.) (£1)	29/–
Sena Sugar Estates Ltd. (10s)	22/3
Tate & Lyle Ltd. (£1)	57/3
Tate & Lyle Investments Ltd. (5s)	17/6
Trinidad Sugar (5s stock units)	28/–
United Molasses (10s stock units)	43/6
West Indies Sugar Co. Ltd. (£1)	21/–

CLOSING MIDDLE

New York Stocks (*at 16th December* 1959)	$
American Crystal ($10)	38½
Amer. Sugar Ref. Co. ($100)	28⅜
Central Aguirre ($5)	26½
Cuban American ($10)	17¼
Great Western Sugar Co.	32¼
South P.R. Sugar Co.	18½
United Fruit Co.	27
West Indies Sugar Corp. ($1)	34⅛

Antigua Sugar Factory Ltd. 1958/59 Report.—Stand-over cane was ground in December 1958 and the 1959 crop started in January. Total production was 31,789 tons of sugar from 272,501 tons of cane, a recovery of 11·68% compared with 10·40% the previous year.

* * *

Austrian beet factory expansions[5].—The sugar factory at Tulln has been modernised during the last year and is now of 4000 tons slicing capacity compared with its original 800 tons per day. The capacity of the factory at Siegendorf has also been raised from 2700 tons to 3500 tons of beet per day.

* * *

Tunisia—France trade agreement.[6]—A trade agreement has been concluded between France and Tunisia which provides for the delivery of Tunisian wine and wheat at French domestic prices in exchange for French sugar.

* * *

New German sugar factory planned[7].—The Süddeutsche Zucker A.G. plans erection of a new sugar factory at Plattling in Lower Bavaria. The new factory is to have a daily slicing capacity of 3000 tons. The object of building the factory is not to expand the company's production but to reduce its campaign from an average of 108 days to 95–100 days.

* * *

Italian sugar surplus.[8]—After the bumper crop of the 1959/60 campaign, Italy is faced with a sugar surplus of 100,000 metric tons, raw value, or perhaps more. Italian sugar exports are limited by the 20,000 tons quota fixed in the International Sugar Agreement which Italy joined as from January 1st, 1959. The situation will undoubtedly adversely affect the Italian sugar economy in the beet campaign to come.

* * *

St. Kitts (Basse Terre) Sugar Factory Ltd. Report 1959.—The crop was disappointing, giving only 46,790 tons of sugar from 415,385 tons of cane. This was partly due to very poor rainfall in the early months on the year and also to a reduced growing period resulting from delayed planting, this being caused by a change in the cotton planting season. Work on the bulk shipping installation is expected to be complete in time to handle the export sugar during the coming crop. Replacement of steam locomotives by diesel locomotives has resulted in a substantial reduction of running costs and fully justified the capital outlay on the change.

* * *

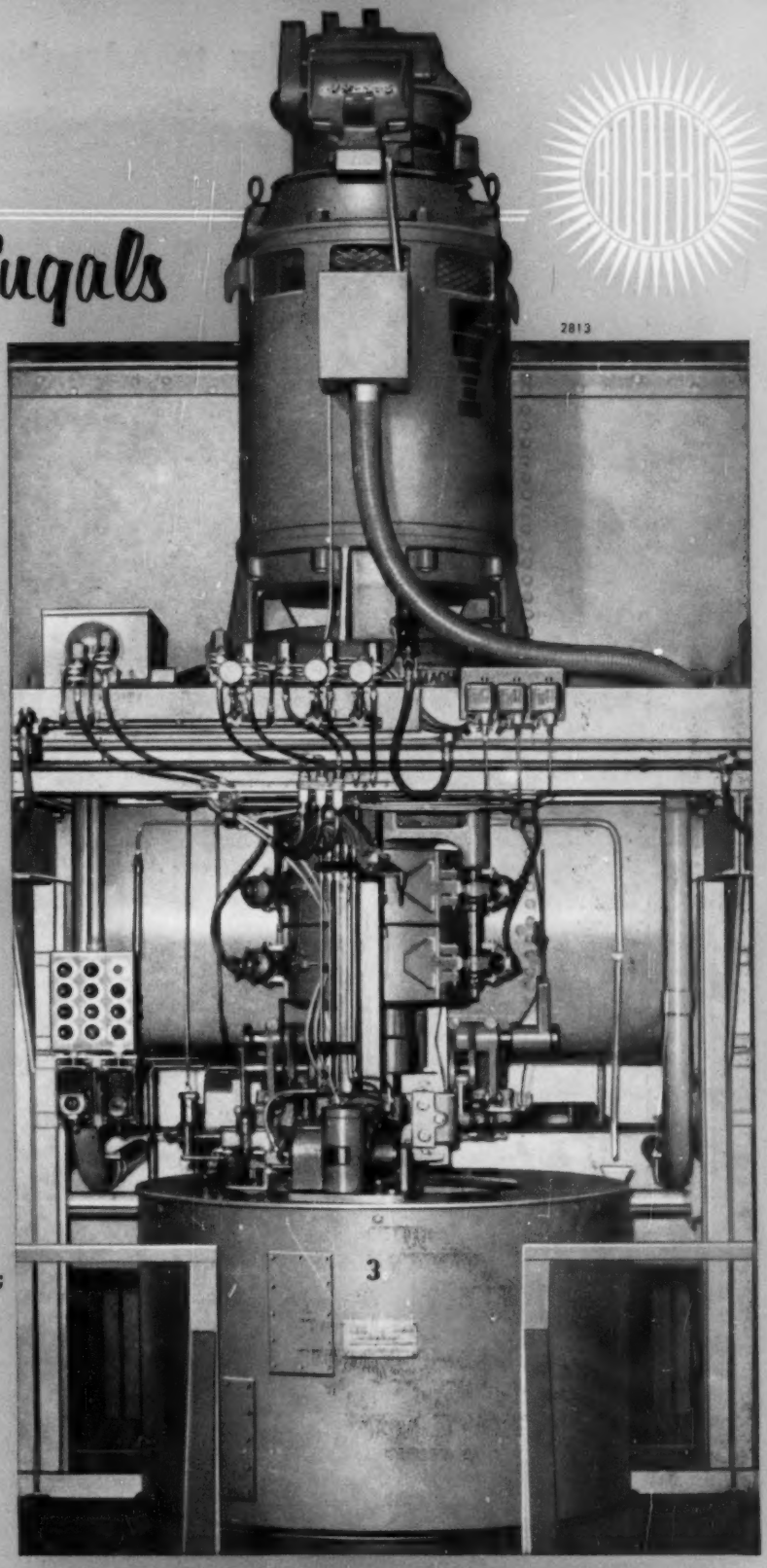
Proposed sugar factory for Venezuela[9].—The establishment of a sugar mill, with adjoining plantations, has been proposed for the town of Cariaco, in the state of Sucre. The project, which is expected to give employment to over 3000 people, envisages an initial production of 15,000 tons of sugar a year, rising to 30,000 tons a year at a later stage. The Ministry of Agriculture and the Banco Agricola y Pecuario are to undertake a scheme to obtain higher yields in Venezuelan sugar cane plantations. Since 1955/56, when production of refined sugar from cane grown in Venezula reached a record level of 208,000 tons or some 78,000 tons more than domestic consumption, production has tended to fall while domestic consumption has risen sharply. Thus, in 1958/59 the production of refined sugar fell to 162,000 tons while domestic demand had risen to 200,000 tons, necessitating substantial imports of raw sugar for refining.

---

[1] *Overseas Review* (Barclays D.C.O.), December 1959, p. 24.
[2] *The Times*, 9th December 1959.
[3] F. O. Licht, *International Sugar Report*, 1959, **91**, (11), 103.
[4] *I.S.J.*, 1959, **61**, 383.
[5] F. O. Licht, *International Sugar Report*, 1959, **91**, (Supp. 22), 293.
[6] F. O. Licht, *International Sugar Report*, 1959, **91**, (11), 112.
[7] F. O. Licht, *International Sugar Report*, 1959, **91**, (Supp. 23), 304.
[8] F. O. Licht, *International Sugar Report*, 1959, **91**, (Supp. 23), 308.
[9] *Fortnightly Review*, (B. [illegible] of London & South America Ltd.), 24th October 1959.

MORE

Roberts Centrifugals



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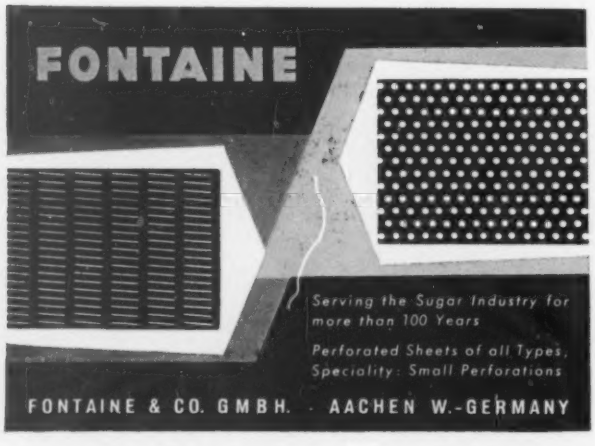
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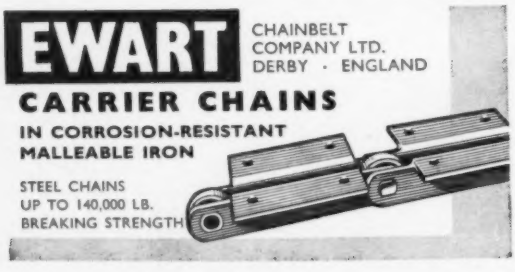

BUYERS' GUIDE

Certain of the classifications have sub-headings for individual types of equipment. Specialist makers appear under these sub-headings, while inclusion of manufacturers under the general headings implies that they supply all or most of the types of equipment described by the sub-headings.

Accumulators, Hydraulic.
George Cohen, Sons & Co. Ltd.
Edwards Engineering Corp.
Soc. Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.

Accumulators, Steam.
see Steam Accumulators.

Air Clutches.
Farrel-Birmingham Co. Inc.

Air Filters.
A.B. Svenska Fläktfabriken
United Norit Sales Corporation Ltd.

Air Heaters.
E. Green & Son Ltd.
A.B. Svenska Fläktfabriken
John Thompson Water Tube Boilers Ltd.
Wellington Tube Works Ltd.

Alcohol Plant.
A.P.V. Co. Ltd., Chemical Engineering Division.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
George Clark & Sons (Hull) Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
Honolulu Iron Works Co.
Lepage, Urbain & Cie.
S. P. E. I. Chim.
Stork-Werkspoor N.V. (V.M.F.)
Technoexport Czechoslovakia.

Asbestos Products.
The Cape Asbestos Co. Ltd.
Johns-Manville International Corp.

Bagasse Depithing Equipment.
Lyddon & Co. Ltd.

Bagasse Furnaces.
Babcock & Wilcox Ltd.
Honolulu Iron Works Co.
John Thompson Water Tube Boilers Ltd.

Bagasse—Paper & Board Production.
Krauss-Maffei-Imperial G.m.b.H. & Co.
Lyddon & Co. Ltd.

Bearings and Pillow Blocks.
Link-Belt Company.
Ransome & Marles Bearing Co. Ltd.
The Skefco Ball Bearing Co. Ltd.
Stephens-Adamson Mfg. Co.

Beet Diffusers, Continuous.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Soc. Fives Lille-Cail.
Etablissements A. Olier.
Salzgitter Maschinen A.G.
Duncan Stewart & Co. Ltd.

Beet Harvesters.
Catchpole Engineering Co. Ltd.

Beet Hoes.
Martin's Cultivator Co. Ltd.
S.K.H. & Son (Salopian-Kenneth Hudson & Son).

Beet Pulp Presses.
Choquenet L. Fonderies et Ateliers.

Beet Seed Rubbing Machines.
Cocksedge & Co. Ltd.

Beet Slicers.
Choquenet L. Fonderies et Ateliers.
Cocksedge & Co. Ltd.
Köllmann & Gruhn
H. Putsch & Comp.

Beet Tail Utilization Plant.
Köllmann & Gruhn
H. Putsch & Comp.

Beet Tare House Equipment.
Cocksedge & Co. Ltd.

Beet Washing Plant.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
Cocksedge & Co. Ltd.
Salzgitter Maschinen A.G.

Bentonite.
F. W. Berk & Co. Ltd.
Farnell Carbons Ltd.
The Fullers' Earth Union Ltd.

Boiler Water Treatment.
Dorr-Oliver Inc., Cane Sugar Divn.
John Thompson-Kennicott Ltd.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.
Unifloc Ltd.

Boilers, Vertical.
Cochran & Co., Annan, Ltd.

Boilers, Water Tube.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
George Cohen, Sons & Co. Ltd.
Davey, Paxman & Co. Ltd.
Foster Wheeler Ltd.
John Thompson Water Tube Boilers Ltd.

Brushware—All Classes.
The Kleen-e-ze Brush Co. Ltd.

Bulk Handling.
see Conveyors *and* Elevators.

Cane Cars and Trailers.
J. Brockhouse & Co. Ltd.
Cary Iron Works.
Robert Hudson Ltd.
Kingston Industrial Works Ltd.
Krupp-Dolberg G.m.b.H.
N.V. Locospoor.
Markham Traction Ltd.
Orenstein & Koppel Ltd.

Cane Cars and Trailers—*continued*
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.S. Industries Inc. (Great Britain) Ltd.
Whitlock Brothers Ltd.

Cane Car Tippers.
Honolulu Iron Works Co.
Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Duncan Stewart & Co. Ltd.
Strachan & Henshaw Ltd.

Cane Carts.
Cary Iron Works.
Robert Hudson Ltd.
Kingston Industrial Works Ltd.
Markham Traction Ltd.
Spoorijzer N.V. Delft.
Whitlock Brothers Ltd.

Cane Cultivation Equipment.
Broussard Machine Co.
Rotary Hoes Ltd.

Cane Harvesters.
Cary Iron Works.

Cane Loaders.
Broussard Machine Co.
Cary Iron Works
Whitlock Brothers Ltd.

Cane Slings.
Robert Hudson Ltd.
Krupp-Dolberg G.m.b.H.
Parsons Chain Co. Ltd.

Carbon, Decolorizing.
Activated Carbons & Chemicals Ltd.
C.E.C.A.
The Clydesdale Chemical Co. Ltd.
Farnell Carbons Ltd.
Lurgi Gesellschaft für Chemotechnik m.b.H.
Suchar Sales Corporation.
The Sugar Manufacturers' Supply Co. Ltd.
United Norit Sales Corporation Ltd.

Carbonatation Equipment.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Dorr-Oliver Inc., Cane Sugar Divn.
George Fletcher & Co. Ltd.
Ateliers Neyret Beylier.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Walter Thron GmbH.

Cement (Sugar-resistant).
Lafarge Aluminous Cement Co. Ltd.

Centrifugals and Accessories.
Birtley Engineering Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd
Maschinenfabrik Buckau R. Wolf A.G.
George Cohen, Sons & Co Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Escher Wyss Ltd.

Centrifugals and Accessories—*continued*
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co., A.G.
Krauss-Maffei-Imperial G.m.b.H. & Co.
Pott, Cassels & Williamson Ltd.
Machinefabriek Reineveld N.V.
Salzgitter Maschinen A.G.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Watson, Laidlaw & Co. Ltd
The Western States Machine Co.

Centrifugal Backings.
Ets Krieg et Zivy.

Centrifugal Motors.
Hinz Elektromaschinen und Apparatebau.
Western States Machine Co.

Centrifugal Screens.
Dorr-Oliver Inc., Cane Sugar Divn.
Ferguson Perforating & Wire Co.
Fontaine & Co.
Hein, Lehmann & Co. A.G.
Ets Krieg et Zivy.
Multi-Metal Wire Cloth Co. Inc.
The Sugar Manufacturers' Supply Co. Ltd.
Tiss-Metal

Chains.
Ewart Chainbelt Co. Ltd.
George Fletcher & Co. Ltd.
John King & Co. (Leeds) Ltd.
Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Parsons Chain Co. Ltd.
Pennine Chainbelt Co. Ltd.
A. & W. Smith & Co. Ltd.

Char Revivifying Plants.
Honolulu Iron Works Co.
Stordy Engineering Ltd.

Chemicals.
Associated Chemical Companies (Sales) Ltd.
The General Chemical & Pharmaceutical Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Lead Acetate, Basic, Doctor Horne's.
Riedel-de Haën A.G.

Sulphur, Roll.
F. W. Berk & Co. Ltd.

Sulphuric Acid.
F. W. Berk & Co. Ltd.

Chemical Plants.
A.P.V. Co. Ltd., Chemical Engineering Division.
Blairs Ltd.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
Davey, Paxman & Co. Ltd.
George Fletcher & Co. Ltd.
L. A. Mitchell Ltd.
P.G. Engineering Ltd.
S.P.E.I. Chim.
Duncan Stewart & Co. Ltd.
John Thompson (Dudley) Ltd.
Unifloc Ltd.

Clarifiers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Dorr-Oliver Inc , Cane Sugar Divn.
Eimco (Great Britain) Ltd.
George Fletcher & Co. Ltd.
Honolulu Iron Works Co.
Johns-Manville International Corp.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Walter Thron GmbH.
Unifloc Ltd.
Westfalia Separator A.G.

Colorimeters.
Degenhardt & Co. Ltd.
Hilger & Watts Ltd.
A. Jobin & G. Yvon.
The Sugar Manufacturers Supply Co. Ltd
Carl Zeiss Jena.

Conveyors and Elevators.
Babcock & Wilcox Ltd.
Birtley Engineering Ltd.
William Boulton Ltd.
Hugh Campbell (London) Ltd.
Cocksedge & Co. Ltd.
George Cohen, Sons & Co. Ltd.
Ewart Chainbelt Co. Ltd.
George Fletcher & Co. Ltd.
William Gardner & Sons (Gloucester) Ltd.
Hein, Lehmann & Co. A.G.
Honolulu Iron Works Co.
John King & Co. (Leeds) Ltd.
Kingston Industrial Works Ltd.
Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Pott, Cassels & Williamson Ltd.
Redler Conveyors Ltd.
A. & W. Smith & Co. Ltd.
Spencer (Melksham) Ltd.
The Squier Corporation.
Strachan & Henshaw Ltd.
Richard Sutcliffe Ltd.
John Thompson Conveyor Co.
Whitlock Brothers Ltd.

Apron Conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Belt and Bucket elevators.
Crone & Taylor (Engineering) Ltd.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Belt Conveyors.
Buhler Brothers.
Crone & Taylor (Engineering) Ltd.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Stephens-Adamson Mfg. Co.
Unifloc Ltd.

Bucket elevators.
Buhler Brothers.
Choquenet L. Fonderies et Ateliers.
Crone & Taylor (Engineering) Ltd.
New Conveyor Co. Ltd.
Sandvik Steel Band Conveyors Ltd.
Unifloc Ltd.

Chain and bucket elevators.
Crone & Taylor (Engineering) Ltd.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Chain conveyors.
Buhler Brothers.
New Conveyor Co. Ltd.
Unifloc Ltd.

Drag-bar conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Feeder conveyors.
Buhler Brothers.
Crone & Taylor (Engineering) Ltd.
Unifloc Ltd.
see also Sugar Throwers and Trimmers.

Flight conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Grasshopper Conveyors.
Birtley Engineering Ltd.
Thomas Broadbent & Sons Ltd.
New Conveyor Co. Ltd.

Plate conveyors.
New Conveyor Co. Ltd.
Unifloc Ltd.

Pneumatic Conveyors.
Buhler Brothers.
Henry Simon Ltd.

Scraper conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Screw conveyors.
Choquent L. Fonderies et Ateliers.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Steel Band Conveyors.
Sandvik Steel Band Conveyors Ltd.
Unifloc Ltd.

"U"-link conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Unifloc Ltd.

Conveyors & Elevators (Mobile).
Buhler Brothers.
Crone & Taylor (Engineering) Ltd.

Conveyor Belt Rotary Brushes.
The Kleen-e-ze Brush Co. Ltd.
Unifloc Ltd.

Coolers, Sugar.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Buell (1952) Ltd.
Büttner-Werke A.G.
Buttner Works Inc.
Buttner Works (Canada) Ltd.
George Clark & Sons (Hull) Ltd.
Dunford & Elliott Process Engineering Ltd.
Honolulu Iron Works Co.
Richard Simon & Sons Ltd.
Standard Steel Corporation.
A.B. Svenska Flaktfabriken
Stork-Werkspoor N.V. (V.M.F.).
see also Dryers.

Coolers, Water.
Film Cooling Towers (1925) Ltd.
Heenan & Froude Ltd.
Holden & Brooke Ltd.

Cranes.
Babcock & Wilcox Ltd.
Cary Iron Works.
George Cohen, Sons & Co. Ltd.
Orenstein & Koppel Ltd.
The Vaughan Crane Co. Ltd.

Crystallizers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
P.G. Engineering Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Standard Steel Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
John Thompson (Dudley) Ltd.

Cube-making Machinery.
Maschinenfabrik Buckau R. Wolf A.G.
Goka N.V. Machine Works.
The Mirrlees Watson Co. Ltd.
Standard Steel Corporation

Cube Sugar Moulding, Ranging and Packeting Plant.
Chambon Ltd.
Goka N.V. Machine Works.
Standard Steel Corporation.

Cube Wrapping Machines.
SAPAL.
SIG Swiss Industrial Company.

Decolorizing Plants.
Farnell Carbons Ltd.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.
United Norit Sales Corporation Ltd.

Decolorizing Resins.
Farnell Carbons Ltd.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Rohm & Haas Company.

Deliming Plants.
Cane Sugar Divn., Dorr-Oliver Inc.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Demineralization Plants.
Cane Sugar Divn., Dorr-Oliver Inc.
IMACTI-Amsterdam.
Paterson Engineering Co. Ltd.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Diatomaceous Earth, *see* **Filter-Aids.**

Distillery Plant *see* **Alcohol Plant.**

Drainage and Ridging Machinery.
James A. Cuthbertson Ltd.
Whitlock Brothers Ltd.

Drives, Variable Speed.
David Brown Industries Ltd., Radicon Divn.
Crofts (Engineers) Ltd.
Heenan & Froude Ltd.

Dryers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Buell (1952) Ltd.
Büttner-Werke A.G.
Buttner Works Inc.
Buttner Works (Canada) Ltd.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
Dunford & Elliott Process Engineering Ltd.
George Fletcher & Co. Ltd.
William Gardner & Sons (Gloucester) Ltd.
Link-Belt Company.
Pott, Cassels & Williamson.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
Spencer (Melksham) Ltd.
The Squier Corporation.
Standard Steel Corporation.
Duncan Stewart & Co. Ltd.
A.B. Svenska Fläktfabriken.
Stork-Werkspoor N.V. (V.M.F.).

Duckboards.
Grill Floors Ltd.

Dust Control Equipment.
Buell (1952) Ltd.
Büttner-Werke A.G.
Dallow Lambert & Co. Ltd.
Dunford & Elliott Process Engineering Ltd.
A.B. Svenska Fläktfabriken.
Carl Zeiss Jena.

Economizers.
George Cohen, Sons & Co. Ltd.
Soc. Fives Lille-Cail.
E. Green & Son Ltd.
John Thompson Water Tube Boilers Ltd.

Electric Heating Tapes and Mantles.
Isopad Ltd.

Electric Motors.
George Cohen, Sons & Co. Ltd.
The Harland Engineering Co. Ltd.
Heemaf N.V.
Hinz Elektromaschinen und Apparatebau.
Lancashire Dynamo & Crypto Ltd.

Electric Power Generators.
George Cohen Sons & Co. Ltd.
Heemaf N.V.
Duncan Stewart & Co. Ltd.

Electronic Equipment.
Cambridge Instrument Co. Ltd.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Lancashire Dynamo Electronic Products Ltd.
Henry Simon Ltd.

Engines, Diesel.
Belliss & Morcom Ltd.
George Cohen, Sons & Co. Ltd.
Davy, Paxman & Co. Ltd.
Orenstein & Koppel Ltd.

Engines, Steam.
Ashworth & Parker Ltd.
Belliss & Morcom Ltd.
Blairs Ltd.
George Cohen, Sons & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.

Engines, Steam—*continued*
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.

Entrainment Separators.
Honolulu Iron Works Co.

Evaporators and Condensing Plant.
A.P.V. Co. Ltd., Industrial Engineering Dept.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia
Walter Thron GmbH.
Wellington Tube Works Ltd.
Worthington-Simpson Ltd.

Filters.
Ashworth & Parker Ltd.
William Boulton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Cohen, Sons & Co. Ltd.
Cotton Bros. (Longton) Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Krauss-Maffei-Imperial G.m.b.H. & Co.
The Mirrlees Watson Co. Ltd.
Schumacher'sche Fabrik.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).

Bag pressure filters.
A. F. Craig & Co. Ltd.
Walter Thron GmbH.

Diatomite filters.
Niagara Filters Europe.
Paterson Engineering Co. Ltd.
Unifloc Ltd.

Filter presses.
Choquenet L. Fonderies et Ateliers.
S. H. Johnson & Co. Ltd.
Unifloc Ltd.

Gravity & Pressure filters.
The Permutit Co. Ltd.

Iron removal filters.
The Permutit Co. Ltd.
Unifloc Ltd.

Leaf filters.
Dorr-Oliver Inc., Cane Sugar Divn.
Ferguson Perforating & Wire Co.

Leaf filters—continued
L. A. Mitchell Ltd.
Niagara Filters Europe.
A. & W. Smith & Co. Ltd.
Sparkler International Ltd.
Suchar Sales Corporation.

Plate and Frame filters.
Blairs Ltd.
Choquenet L. Fonderies et Ateliers.
S. H. Johnson & Co. Ltd.
John McNeil & Co. Ltd.

Pressure filters.
Dorr-Oliver Inc., Cane Sugar Divn.
Eimco (Gt. Britain) Ltd.
Filtres Philippe S.A.
Niagara Filters Europe.
The Permutit Co. Ltd.
Suchar Sales Corporation.

Rotary vacuum filters.
Davey, Paxman & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Eimco (Gt. Britain) Ltd.
Filtres Philippe S.A.
H. Putsch & Comp.
Unifloc Ltd.

Upflow filters.
IMACTI Amsterdam.

Filter-Aids.
F. W. Berk & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
C.E.C.A.
Dicalite Dept., Great Lakes Carbon Corp.
Farnell Carbons Ltd.
T. B. Ford Limited.
Haller & Phillips Ltd.
Johns-Manville International Corp.
The Sugar Manufacturers' Supply Co. Ltd.
Chas. H. Windschuegl Ltd.

Filtercloths.
British Ropes Ltd.
Cotton Bros. (Longton) Ltd.
Heath Filtration Ltd.
G. H. Heath & Son (1952) Ltd.
Samuel Hill Ltd.
S. H. Johnson & Co. Ltd.
Multi-Metal Wire Cloth Co. Inc.
Henry Simon Ltd.
Tiss-Metal.

Filter-Leaves.
Dorr-Oliver Inc., Cane Sugar Divn. (*Sweetland*).
Enzinger Division, The Duriron Co. Inc. (Angola).
Ferguson Perforating & Wire Co.
Multi-Metal Wire Cloth Co. Inc.
Niagara Filters Europe.
A. & W. Smith & Co. Ltd.
Sparkler International Ltd.

Filter Papers.
W. & R. Balston Ltd.
T. B. Ford Limited.
The General Chemical & Pharmaceutical Co. Ltd.
G. H. Heath & Son (1952) Ltd.
S. H. Johnson & Co. Ltd.
Carl Schleicher & Schüll.
The Sugar Manufacturers' Supply Co. Ltd.

Flanges.
Kirk & Co. (Tubes) Ltd. (*Steel, Stainless Steel*)

Flowmeters.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.
Wright Rain Ltd. (*Irrigation*).
Wright Rain Africa (Pvt.) Ltd. (*Irrigation*).

Friction Materials (Industrial).
Johns-Manville International Corp.

Fullers' Earth.
The Fullers' Earth Union Ltd.

Gearing, *see* Reduction Gears.

Gearmotors.
David Brown Industries Ltd., Coventry Gear Divn.
Crofts (Engineers) Ltd.
Hinz Elektromaschinen und Apparatebau.

Grabs, Cane and Beet.
Joseph Westwood & Co. Ltd.

Granulators, *see* Dryers.

Heat Exchangers, Air-cooled.
Wellington Tube Works Ltd.

Heat Exchangers, Plate Type.
A.P.V. Co. Ltd., Chemical Engineering Division.
Babcock & Wilcox Ltd.
British Boiler Accessories Ltd.
George Cohen, Sons, & Co. Ltd.

Heat Exchangers, Tubular.
A.P.V. Co. Ltd., Industrial Engineering Dept.
Babcock & Wilcox Ltd.
Blairs Ltd.
British Boiler Accessories Ltd.
George Clark & Sons (Hull Ltd.
George Fletcher & Co. Ltd.
Foster Wheeler Ltd.
Holden & Brooke Ltd.
S.P.E.I. Chim
John Thompson Water Tube Boilers Ltd.
Wellington Tube Works Ltd.

Hydraulic Controls for Valves, etc.
Edwards Engineering Corp.
Duncan Stewart & Co. Ltd.

Instruments, Process Control.
Beckman Instruments Inc.
Bellingham & Stanley Ltd.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Hilger & Watts Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.

Insulation, Thermal (Heat and Cold).
The Cape Asbestos Co. Ltd.
Johns-Manville International Corp.
Lafarge Aluminous Cement Co. Ltd.

Ion Exchangers.
W. & R. Balston Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Farnell Carbons Ltd.

Ion Exchangers—*continued*
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Rohm & Haas Company.
John Thompson-Kennicott Ltd.

Irrigation Equipment.
Evenproducts, Evesham.
Farrow & Sons Ltd.
Markham Traction Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Jointings, *see* Packings and Gaskets.

Juice Heaters.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
George Clark & Sons (Hull) Ltd.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
Walter Thron GmbH.

Juice Scales.
Butz & Leitz G.m.b.H.
George Fletcher & Co. Ltd.
Richardson Scale Co. Ltd.
N.V. Servo-Balans.
see also Weighing Machines.

Juice Strainers and Screens.
Ashworth & Parker Ltd.
Blairs Ltd.
William Boulton Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
Cocksedge & Co. Ltd.
Dei-Con Eastern Corporation.
Dorr-Oliver Inc., Cane Sugar Divn.
Ferguson Perforating & Wire Co.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Kingston Industrial Works Ltd.
Link-Belt Company.
John McNeil & Co. Ltd.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Juice and Syrup Mixers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
George Clark & Sons (Hull) Ltd.
Gutehoffnungshütte Sterkrade A.G.
L. A. Mitchell Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd

Knives, Beet.
Köllmann & Gruhn.
H. Putsch & Comp.

Knives, Milling.
Blairs Ltd
BMA Braunschweigische Maschinenbauanstalt.
Broussard Machine Co.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd
Farrel-Birmingham Co. Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.

Knives, Milling, Portable Grinders.
Flexotube (Liverpool) Ltd.

Laboratory Apparatus and Equipment.
The Sugar Manufacturers' Supply Co. Ltd.
The Tintometer Ltd.

Electric Heating appliances.
Isopad Ltd.
see also Laboratory Instruments *and* Saccharimeters and Polarimeters, *etc.*

Laboratory Instruments.
Beckman Instruments Inc.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Degenhardt & Co. Ltd.
Ericsson Telephones Ltd.
Evershed & Vignoles Ltd.
A. Jobin & G. Yvon.
Rotameter Manufacturing Co. Ltd.
Sugar Manufacturers' Supply Co. Ltd.
John Thompson Instrument Co. Ltd.
Carl Zeiss Jena.

Refractometers.
Bellingham & Stanley Ltd.
Hilger & Watts Ltd.
Schmidt & Haensch.

Laboratory Reagents.
The General Chemical & Pharmaceutical Co. Ltd.
Riedel-de Haën A.G.
The Sugar Manufacturers' Supply Co. Ltd.

Ladders, Steel Lattice.
Grill Floors Ltd.

Lime Density Meters.
Rotameter Manufacturing Co. Ltd.

Liming Equipment.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cocksedge & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Sugar Manufacturers' Supply Co. Ltd.
Unifloc Ltd.

Locomotives, Diesel.
Andrew Barclay, Sons & Co. Ltd.
George Cohen, Sons & Co. Ltd.
F. C. Hibberd & Co. Ltd.
Robert Hudson Ltd.
Hudswell, Clarke & Co. Ltd.
Hunslet Engine Co. Ltd.
Krupp-Dolberg G.m.b.H.
N.V. Locospoor.
Orenstein & Koppel Ltd.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.S. Industries Inc. (Great Britain) Ltd.

Magnetic Separators.
Electromagnets Ltd.
Permag Ltd.
Rapid Magnetic Ltd.
Unifloc Ltd.

Massecuite Heat Treating Equipment.
Blairs Ltd.
George Fletcher & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Pott, Cassels & Williamson Ltd.
A. & W. Smith & Co. Ltd.
The Western States Machine Co. (*Stevens System*).

Mechanical Crop Thinning Machines.
S.K.H. & Son (Salopian–Kenneth Hudson & Son).

Metal Detectors.
Metal Detection Ltd.

Mill Hydraulics.
Edwards Engineering Corp.
The Mirrlees Watson Co. Ltd.
Duncan Stewart & Co. Ltd.

Mill Rolls.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
G. M. Hay & Co. Ltd.
Honolulu Iron Works Co.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.

Mill Roll Movement Indicators and Recorders.
Edwards Engineering Corp.

Milling Plant.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
David Brown Industries, Ltd., General Gear Division.
David Brown Industries Ltd., Jackson Division.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Farrel-Birmingham Co. Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
G. M. Hay & Co. Ltd.
Honolulu Iron Works Co.
Kek Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.

Milling Plant—*continued*
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia.
see also Shredders.

Molasses Tanks.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
Kingston Industrial Works Ltd.
Mechans Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.

Packeting Machinery.
Brecknell, Dolman & Rogers Ltd.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.
Richard Simon & Sons Ltd.
SIG Swiss Industrial Company.

Packings and Gaskets.
The Cape Asbestos Co. Ltd.
Johns-Manville International Corp.

Pans, Vacuum.
A.P.V. Co. Ltd., Industrial Engineering Dept.
Blairs Ltd.
William Boulton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
John McNeil & Co. Ltd.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
Technoexport Czechoslovakia.
John Thompson (Dudley) Ltd.

Paper and Board from Bagasse.
Lyddon & Co. Ltd.

Pipes, Steam.
Kirk & Co. (Tubes) Ltd.
Duncan Stewart & Co. Ltd.
Talbot Stead Tube Co. Ltd.
Wellington Tube Works Ltd.

Pipe Fittings.
see Tube Fittings.

Ploughs—Disc.
David Brown Industries Ltd., Tractor Division.
Krupp-Dolberg G.m.b.H.
Martin's Cultivator Co. Ltd.
Ransomes Sims & Jefferies Ltd.
S.K.H. & Son (Salopian–Kenneth Hudson & Son).

Ploughs—Reversible.
Ransomes, Sims & Jefferies Ltd.
S.K.H. & Son (Salopian—Kenneth Hudson & Son)

Ploughs—Share.
David Brown Industries Ltd., Tractor Division.
Krupp-Dolberg G.m.b.H.
Ransomes Sims & Jefferies Ltd.

Portable Water Mains.
Evenproducts, Evesham.

Power Transmission Equipment.
Crofts (Engineers) Ltd.
Farrel-Birmingham Co. Inc.
Heenan & Froude Ltd.

Pressure Gauges.
The British Rototherm Co. Ltd.

Printing Machinery—Rotary Multi Colour for Sugar Cartons and Bags, etc.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.

Pulverizers, Sugar.
George Cohen, Sons & Co. Ltd.
Gruendler Crusher & Pulverizer Co.
Kek Ltd.
Henry Simon Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Pumps.
BMA Braunschweigische Maschinenbauanstalt.
Cellulose Development Corp. Ltd.
George Cohen, Sons & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
The Harland Engineering Co. Ltd.
Holden & Brooke Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Worthington-Simpson Ltd.

Boiler Feed pumps.
The Permutit Co. Ltd.
Saunders Valve Co. Ltd.

Centrifugal pumps.
Saunders Valve Co. Ltd.

Corrosion-proof pumps.
A.P.V. Co. Ltd., Industrial Engineering Dept.
L. A. Mitchell Ltd.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.

Gear pumps.
David Brown Industries Ltd., General Gear Divn.

Irrigation Pumps.
Farrow & Sons Ltd.
Markham Traction Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Molasses Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.

Positive-action Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.

Rotary Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.
Machinefabriek Reineveld N.V.

Self-Priming Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.

Sump Pumps.
Saunders Valve Co. Ltd.

Vacuum Pumps.
see Vacuum Pumps.

Railway, *see* Locomotives *and* Track.

Reduction Gears.
David Brown Industries Ltd., General Gear Division.
David Brown Industries Ltd., Radicon Divn.
Maschinenfabrik Buckau R. Wolf A.G.
George Cohen, Sons & Co. Ltd.
Crofts (Engineers) Ltd.
Farrel-Birmingham Co. Inc. (Gloucester) Ltd.
The Power Plant Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
John Thompson Ordnance Co.

Refinery Equipment.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stordy Engineering Ltd.
Suchar Sales Corporation.
Technoexport Czechoslovakia.

Refractory Bricks.
General Refractories Ltd.
Johns-Manville International Corp.
John G. Stein & Co. Ltd.

Refractory Cement.
General Refractories Ltd.
Johns-Manville International Corp.
Lafarge Aluminous Cement Co. Ltd
John G. Stein & Co. Ltd.

Refractory Concretes.
John G. Stein & Co. Ltd.

Rotary Hoes.
Rotary Hoes Ltd.

Rubber Belt Cane Carriers.
Farrel-Birmingham Co. Inc.

Saccharimeters and Polarimeters.
Bellingham & Stanley Ltd.
Degenhardt & Co. Ltd.
Ericsson Telephones Ltd.
Hilger & Watts Ltd.
A. Jobin & G. Yvon.
Schmidt & Haensch.
The Sugar Manufacturers' Supply Co. Ltd.
Carl Zeiss Jena.

Sack Closing Machines.
Thomas C. Keay Ltd.
The Sack Filling & Sewing Machine Syndicate Ltd.

Sack Filling Machines.
Brecknell, Dolman & Rogers Ltd.
Librawerk.
Richardson Scale Co. Ltd.
Richard Simon & Sons Ltd.

Sack Printing Machines.
Thomas C. Keay Ltd.

Sampling Equipment.
Birtley Engineering Ltd.

Scaffold boards.
Grill Floors Ltd.

Scale Removal and Prevention.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
The Geigy Company Ltd.
The Kleen-e-ze Brush Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Screens, Centrifugal, *see* Centrifugal Screens.

Screens, Vibrating.
William Boulton Ltd.
Büttner-Werke A.G.
Cocksedge & Co. Ltd.
Dei-Con Eastern Corporation.
Electromagnets Ltd.
William Gardner & Sons (Gloucester) Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co. A.G.
John McNeil & Co. Ltd.
Multi-Metal Wire Cloth Co. Inc.
Spencer (Melksham) Ltd.
Duncan Stewart & Co. Ltd.
Sugar Manufacturers' Supply Co. Ltd.
Tiss-Metal.
Unifloc Ltd.
see also Juice Strainers and Screens.

Self-cleaning Strainers.
Ashworth & Parker Ltd.

Ship Loading installations.
Buhler Brothers.
Crone & Taylor (Engineering) Ltd.

Shredders.
BMA Braunschweigische Maschinenbauanstalt.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gruendler Crusher & Pulverizer Co.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd.

Skip Hoists.
Babcock & Wilcox Ltd.
Hugh Campbell (London) Ltd.
Crone & Taylor (Engineering) Ltd.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Spencer (Melksham) Ltd.
Strachan & Henshaw Ltd.
Richard Sutcliffe Ltd.

Spectrophotometers.
Beckman Instruments Inc.
Degenhardt & Co. Ltd.
Hilger & Watts Ltd.
A. Jobin & G. Yvon.
Carl Zeiss Jena.

Spray nozzles.
Dei-Con Eastern Corporation.

Spraying and Dusting Machinery.
Cooper, Pegler & Co. Ltd.

Steam Accumulators.
British Boiler Accessories Ltd.
Cochran & Co., Annan, Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Steam Storage Equipment.
see Steam Accumularors.

Steam Superheaters.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Foster Wheeler Ltd.
John Thompson Water Tube Boilers Ltd.

Steam Traps.
von Arnim'sche Werke G.m.b.H.

Steam Turbines for Mill Drives, etc.
Belliss & Morcom Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Escher Wyss Ltd.
Soc Fives Lill-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.

Steel.
George Cohen, Sons & Co. Ltd.

Steel Bar and Wire.
Talbot Stead Tube Co. Ltd.

Steel Flooring and Handrailing.
Grill Floors Ltd.

Stokers—Bagasse Burning Spreader Type.
Babcock & Wilcox Ltd.

Sugar Factory Design and Erection (Cane and Beet).
Honolulu Iron Works Co.
Salzgitter Industriebau G.m.b.H.

Sugar Machinery, General.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.

Sugar Machinery, General—*continued*
Kingston Industrial Works Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia.

Sugar Throwers and Trimmers.
Crone & Taylor (Engineering) Ltd.
Kingston Industrial Works Ltd.
Spencer (Melksham) Ltd.
Stephens-Adamson Mfg. Co.

Switchgear.
Heemaf N.V.

Temperature Recorders and Controllers.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.

Thermometers.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Taylor Controls Ltd.

Track and Track Accessories.
Robert Hudson Ltd.
Krupp-Dolberg G.m.b.H.
N.V. Locospoor.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.S. Industries Inc. (Great Britain) Ltd.

Tractors.
David Brown Industries, Tractor Divn.
Marshall Sons & Co. Ltd.

Trailers.
Cary Iron Works.
Robert Hudson Ltd.
Markham Traction Ltd.
Spoorijzer N.V. Delft.
Whitlock Brothers Ltd.

Trench Gratings.
Grill Floors Ltd.

Tubes, Bi-Metal.
Talbot Stead Tube Co. Ltd
Yorkshire Imperial Metals Ltd.

Tubes for Boilers, Evaporators, Juice Heaters, Vacuum Pans, etc.
Babcock & Wilcox Ltd.
Hudson & Wright Ltd.
Kirk & Co. (Tubes) Ltd.
Talbot Stead Tube Co. Ltd.
Yorkshire Imperial Metals Ltd.

Tubes, Carbon, Alloy and Stainless Steel
Kirk & Co. (Tubes) Ltd.
Talbot Stead Tube Co. Ltd.

Tube Cleaners, *see* Scale Removal and Prevention.

Tube Fittings.
A.P.V. Co. Ltd., Industrial Engineering Dept. (*stainless steel*)
Blakey's Boot Protectors Ltd. (*malleable iron*).

Tube Fittings—*continued*
Kirk & Co. (Tubes) Ltd. (*malleable iron and stainless steel*)
Talbot Stead Tube Co. Ltd. (*stainless steel*).
Yorkshire Imperial Metals Ltd. (*copper, brass and plastic*)

Vacuum Pans, *see* Pans.

Vacuum Pumps.
Belliss & Morcom Ltd.
Blairs Ltd.
George Cohen, Sons & Co. Ltd.
Comet Pump & Engineering Co Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Holden & Brooke Ltd.
The Mirrlees Watson Co. Ltd.
Ateliers Neyret Beylier.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Worthington-Simpson Ltd.

Valves.
A.P.V. Co. Ltd., Industrial Engineering Dept.
von Arnim'sche Werke G.m.b.H.
David Brown Industries Ltd., Foundries Divn.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
Kirk & Co. (Tubes) Ltd.
The Lunkenheimer Company.
Saunders Valve Co. Ltd.
Talbot Stead Tube Co. Ltd.
Taylor Controls Ltd.

Variable Speed Controls.
Crofts (Engineers) Ltd.
Heenan & Froude Ltd.
Duncan Stewart & Co. Ltd.

Vehicle washes.
Grill Floors Ltd.

Water Cooling Towers.
Film Cooling Towers (1925) Ltd.
Foster Wheeler Ltd.
AB. Svenska Fläktfabriken.

Weighing Machines.
Adequate Weighers Ltd.
Butz & Leitz G.m.b.H.
Chronos Werk, Reuther & Reisert K.G.
Electroweighers (Birmingham) Ltd.
Fr. Hesser Maschinenfabrik A.G.
Librawerk.
Richardson Scale Co. Ltd.
N.V. Servo-Balans.
Richard Simon & Sons Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
see also Juice Scales.

Wire Cloth.
Ferguson Perforating & Wire Company.
Fontaine & Co.
Multi-Metal Wire Cloth Co. Inc.
Tiss-Metal.
Unifloc Ltd.

Wrapping machines.
SAPAL.
SIG Swiss Industrial Company.

BUYERS' GUIDE—ADDRESS LIST

Activated Carbons & Chemicals Ltd.
Burnfield Road, Giffnock, Glasgow, Scotland.
Tel.: Merrylee 2393. *Cable* : Stedmacs, Giffnock.

Adequate Weighers Ltd.,
Bridge Works, Bridge Road, Sutton, Surrey, England.
Tel. : Vigilant 6666/7/8. *Cable* : Adegrate, London.

The A.P.V. Co. Ltd.,
Manor Royal, Crawley, Sussex.
Tel. : Crawley 1360. *Cable* : Anaclastic, Crawley.
Telex : 8737

von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke,
Offenbach/Main, Germany.
Tel.: Offenbach 82054.
Cable: Kondenstopf, Offenbach/Main.

Ashworth & Parker Ltd.,
Riverside Works, Bury, Lancs., England.
Tel. : Bury 5125–6. *Cable* : Kinetic, Bury.

Associated Chemical Companies (Sales) Ltd.,
P.O. Box 6, Brotherton House, Westgate, Leeds 1, England.
Tel.: Leeds 29321/8. *Cable* : Aschem, Leeds
Telex : 55–116.

Babcock & Wilcox Ltd.,
Babcock House, 209 Euston Rd., London, N.W.1, England.
Tel.: Euston 4321. *Cable:* Babcock, London.
Telex: 23256.

W. & R. Balston Ltd.,
see H. Reeve Angel & Co. Ltd.

Andrew Barclay Sons & Co., Ltd.
Caledonia Works, Kilmarnock, Scotland.
Tel.: Kilmarnock 1366/7. *Cable:* Barclayson, Kilmarnock.

Beckman Instruments Inc.
Fullerton, California, U.S.A.
Tel.: Trojan 1–4848. *Cable* : Beckman, Fullerton.
Telex : Fullerton 5210.

Bellingham & Stanley Ltd.,
71 Hornsey Rise, London, N.19, England.
Tel. : Archway 2270. *Cable* : Polyfract, London.

Belliss & Morcom Ltd.,
Ledsam Street Works, Birmingham 16, England.
Tel. : Edgbaston 3531. *Cable* : Belliss, Birmingham 16.

F. W. Berk & Co. Ltd.,
Berk House, Portman Square, London, W.1.
Tel. : Hunter 6688. *Cable* : Berk, London.
Telex: 23796.

Birtley Engineering Ltd.,
Birtley, County Durham, England.
Tel.: Birtley 248/9. *Cable* : Birtley, Newcastle-upon-Tyne

Blairs Ltd.,
Glasgow Engineering Works, Woodville Street, Govan, Glasgow, S.W.1, Scotland.
Tel. : Govan 1261 *Cable* : Blazon, Glasgow.

Blakey's Boot Protectors Ltd.,
see Pennine Chainbelt Co. Ltd.

BMA Braunschweigische Maschinenbauanstalt,
(20b) Braunschweig, Bahnhofstrasse 5, Germany.
Tel. : Braunschweig 23691. *Cable* : Bema, Braunschweig.
Telex : Bema Bswg. 0952840

William Boulton Ltd.,
Providence Engineering Works, Burslem, Staffs., England.
Tel.: Stoke-on-Trent 88661. *Cable:* Boultons, Burslem.

Brecknell, Dolman & Rogers Ltd.,
Pennywell Road, Bristol 5, England.
Tel.: Bristol 58222. *Cable:* Bremaners, Bristol.

British Boiler Accessories Ltd.
62/63 Fenchurch Street, London E.C.3., England.
Tel.: Royal 4122/6305. *Cable* : Boileracs, London

British Ropes Ltd.,
Leith, Edinburgh 6, Scotland.
Tel.: Leith 36811. *Cable:* Roperie, Leith.
Telex: 72278.

The British Rototherm Co. Ltd.,
Merton Abbey, London S.W.19, England.
Tel.: Liberty 7661. *Cable:* Rototherm, London.

Thomas Broadbent & Sons Ltd.,
Central Ironworks, Huddersfield, England.
Tel : Huddersfield 5520. *Cable* : Broadbent, Huddersfield.

J. Brockhouse & Co. Ltd.,
Victoria Works, Hill Top, West Bromwich, Staffs., England.
Tel. : Wednesbury 0243.
Cable : Brockhouse, West Bromwich.

Broussard Machine Company,
see Logan Perkins.

David Brown Corporation (Sales) Ltd.,
96/97 Piccadilly, London, W.1, England.
Tel. : Grosvenor 5271. *Cable* : Davibron, London

David Brown Industries Ltd., Coventry Gear Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Foundries Division.
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., General Gear Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Jackson Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Radicon Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Tractor Division,
see David Brown Corporation (Sales) Ltd.

Maschinenfabrik Buckau R. Wolf A.G.,
Grevenbroich/Ndrrh., Germany.
Tel. : Grevenbroich 1481.
Cable : Maschinenbau, Grevenbroich.
Telex : 08517111.

Buell (1952) Ltd.,
3 St. James's Square, London, S.W.1, England.
Tel. : Trafalgar 2528. *Cable* : Allentare, London.

Buhler Brothers,
Uzwil, Switzerland.
Tel.: 65212 Uzwil *Cable* : Buhler, Uzwil.
Telex : 57202

Büttner-Werke A.G.,
Postfach 59, Krefeld-Uerdingen 1, Germany.
Tel.: Krefeld 43511. *Cable:* Büttner, Krefeld-Uerdingen.

Buttner Works Inc.
52 Vanderbilt Avenue, New York 17, N.Y., U.S.A.
Tel.: Murray Hill 9–5098. *Cable* : Buttnerusa, New York.

Buttner Works (Canada) Ltd.,
P.O. Box 688, Montreal, Quebec, Canada.
Tel.: RE–7–9053 *Cable* : Buttner, Montreal.

Butz & Leitz G.m.b.H.,
(22b) Ludwigshafen a. Rh., Industriestrasse, Germany.
Tel.: Ludwigshafen 63618/9, 64003.
Cable : Butzleitz, Ludwigshafenrhein.

Cambridge Instrument Co. Ltd.,
13 Grosvenor Place, London S.W.1., England.
Tel.: Belgravia 5066. *Cable :* Unipivot, London.

Hugh Campbell (London) Ltd.,
Kent House Lane, Beckenham, Kent, England.
Tel.: Sydenham 8178, 8238. *Cable:* Mechandle, Beckenham.

The Cape Asbestos Co. Ltd.,
114 & 116 Park Street, London, W.1., England.
Tel.: Grosvenor 6022. *Cable:* Incorrupt, London.

Cary Iron Works,
see Logan Perkins.

Catchpole Engineering Co. Ltd.,
Bury St. Edmunds, Suffolk, England.
Tel.: Bury St. Edmunds 2591.
Cable: Beslift, Bury St. Edmunds.

C.E.C.A.,
24 Rue Murillo, Paris 8e, France.
Tel. · Car 8200. *Cable :* Ceca, Paris.

Chambon Ltd.,
Riverside Works, Standish Road, London W.6., England.
Tel.: Riverside 6086. *Cable:* Chambonted, London.

Choquenet L. Fonderies et Ateliers—Sté. Ame,
Chauny (Aisne), France.
Tel. Chauny 34.

Chronos Werk, Reuther & Reisert K.G.,
Hennef-Sieg (Rhld), Germany.
Tel.: Sa. Nr. 2381/83. *Cable :* Chronos, Hennefsieg.
Telex : 8/869224

George Clark & Sons (Hull) Ltd.,
Hawthorn Avenue, Hull, England.
Tel.: Hull 37654. *Cable:* Clark, Hull.

The Clydesdale Chemical Co. Ltd.,
105 Millerston Street, Glasgow, E.1, Scotland.
Tel. : Bridgeton 4374. *Cable :* Cactus, Glasgow

Cochran & Co., Annan, Ltd.,
Annan, Dumfriesshire, Scotland.
Tel: Annan 111. *Cable* : Multitube, Annan.

Cocksedge & Co. Ltd.,
Grey Friars Road, Ipswich, Suffolk, England.
Tel.: Ipswich 56161. *Cable:* Cocksedge, Ipswich.

George Cohen, Sons & Co. Ltd.,
58 Wood Lane, London, W.12, England.
Tel. : Shepherds Bush 2070. *Cable :* Omniplant, London.
Telex : 2–2461.

Comet Pump & Engineering Co. Ltd.,
Johnson Road, West Croydon, Surrey, England.
Tel. : Thornton Heath 3816. *Cable :* Comet, Croydon.

Cooper, Pegler & Co. Ltd.,
P.O. Box 9–98, Burgess Hill, Sussex, England.
Tel.: Burgess Hill 2525. *Cable :* Stomata, Burgess Hill.

Cotton Bros. (Longton) Ltd.,
Crown Works, Portland Road, Longton, Stoke-on-Trent, Staffs., England.
Tel.: Longton 33021. *Cable:* Cotbro, Stoke-on-Trent.

A. F. Craig & Co. Ltd..
Caledonia Engineering Works, Paisley, Scotland.
Tel. : Paisley 2191. *Cable :* Craig, Paisley.

Crofts (Engineers) Ltd.,
Thornbury, Bradford 3, Yorkshire, England.
Tel. : Bradford 65251. *Cable :* Crofters, Bradford.
Telex : 51186.

Crone & Taylor (Engineering) Ltd.,
Sutton Oak, St. Helens, Lancs., England.
Tel.: St. Helens 3283/5 *Cable:* Crontaylor, St. Helens.

James A. Cuthbertson Ltd.,
Station Road, Biggar, Lanarkshire, Scotland.
Tel.: Biggar 20. *Cable:* Mechadrain, Biggar.

C.Z. Scientific Instruments Ltd.,
12a Golden Square, London W.1., England.
Tel.: Gerrard 4488 *Cable:* Cezet, London.

Dallow, Lambert & Co. Ltd.,
Thurmaston, Leicester, England.
Tel.: Syston 3333. *Cable:* Dust, Leicester.

Davey, Paxman & Co. Ltd.,
Standard Iron Works, Colchester, Essex, England.
Tel. : Colchester 5151. *Cable :* Paxman, Colchester.
Telex : 1875.

Degenhardt & Co. Ltd.,
6 Cavendish Square, London W.1., England.
Tel.: Langham 6097/9.

Dei-Con Eastern Corporation,
Eastern Hemisphere Export Sales Divn., The Deister Concentrator Co. Inc.,
60 Beaver St., New York 4, N.Y., U.S.A.
Tel.: Digby 4–7389. *Cable :* Retsied, New York.

Dicalite Department, Great Lakes Carbon Corp.,
18 East 48th Street, New York 17, N.Y., U.S.A.
Tel. : Eldorado 5–6200. *Cable :* Dicalite, New York.

Dorr-Oliver Inc., Cane Sugar Division,
Stamford, Conn., U.S.A.

Dunford & Elliott Process Engineering Ltd.,
Linford Street, London, S.W.8, England.
Tel. : Macaulay 2405. *Cable :* Lindaresco, London.

Edwards Engineering Corp.,
715 Camp Street, New Orleans 12, La., U.S.A.
Tel. : Tulane 0175. *Cable :* Joedco, New Orleans.

Eimco (Great Britain) Ltd.,
Earlsway, Team Valley, Gateshead 11, England.
Tel. : Low Fell 7–7241. *Cable :* Eimco, Gateshead.

Electroflo Meters Co. Ltd.,
Abbey Road, Park Royal, London, N.W.10, England.
Tel.: Elgar 7641/8. *Cable:* Elflometa, London.
Telex: 2–3196.

Electromagnets Ltd.,
Boxmag Works, Bond St., Hockley, Birmingham, England.
Tel.: Central 5391–3. *Cable:* Boxmag, Birmingham.

Electroweighers (Birmingham) Ltd.,
Moseley St., Birmingham 12, England.
Tel.: Victoria 2223 *Cable.:* Elecweigh, Birmingham.

Ericsson Telephones Ltd., Instrument Division,
High Church St., New Basford, Nottingham, England.
Tel.: Nottingham 75115. *Cable:* Ericsson, Nottingham

Escher Wyss Ltd.,
Terminal House, 52 Grosvenor Gardens, London, S.W.1, England.
Tel. : Sloane 8101. *Cable :* Escherwyss, London.

Evenproducts, Evesham,
Evesham, Worcestershire, England.
Tel.: Evesham 2547 *Cable :* Evenproducts, Evesham.

Evershed & Vignoles Ltd.,
Chiswick, London, W.4, England.
Tel. : Chiswick 3670. *Cable :* Megger, London.
Telex : 22–583.

Ewart Chainbelt Co. Ltd.,
Colombo Street, Derby, England.
Tel. : Derby 45451. *Cable :* Chainbelt, Derby.

Farnell Carbons Ltd.,
Conduit Road, Plumstead, London, S.E.18, England.
Tel : Woolwich 1158. *Cable :* Scofar, London.

Farrel-Birmingham Co. Inc.,
Ansonia, Conn., U.S.A.
Tel.: Regent 4–3331.

Farrow & Sons Ltd.,
Spalding, Lincs., England.
Tel.: Spalding 3388. *Cable:* Farrows, Spalding.

Ferguson Perforating & Wire Co.,
130–140 Ernest Street, Providence, R.I., U.S.A.
Tel. : Williams 1–8876. *Cable :* Ferguson, Providence.

Film Cooling Towers (1925) Ltd.,
Chancery House, Parkshot, Richmond, Surrey, England.
Tel.: Richmond 6494/8. *Cable:* Aloof, Richmond.

Filtres Philippe S.A.,
109 Blvd. Henri-Barbusse, (P.O. Box 30) Houilles (S. & O.), France.
Tel.: 961–79–90. *Cable :* Alfilipe, Houilles.
Telex : 2–3–155.

Société de Fives Lille-Cail,
7 Rue Montalivet, Paris 7e, France.
Tel.: Anjou 22–01. *Cable:* Fivcail, Paris.

George Fletcher & Co. Ltd.,
Masson Works, Litchurch Lane, Derby, England.
Tel. : Derby 45817. *Cable :* Amarilla, Derby.

Flexible Drives (Gilmans) Ltd.,
Carlton House, High Street, Smethwick, Staffs., England.
Tel. : Smethwick 1202. *Cable :* Skatoskalo, Birmingham.

Flexotube (Liverpool) Ltd.,
25, Hope Street, Liverpool 1, England.
Tel.: Royal 3345. *Cable :* Flexotube, Liverpool.

Fontaine & Co.,
Aachen, Germany.

T. B. Ford Ltd.,
30 New Bridge Street, London E.C.4., England.
Tel.: City 2272. *Cable :* Fordfilt, London.

Foster Wheeler Ltd.,
3 Ixworth Place, London, S.W.3, England.
Tel. : Kensington 6363. *Cable :* Rewop, London.
Telex : London 23442.

The Fullers' Earth Union Ltd.,
Patteson Court, Nutfield Road, Redhill, Surrey, England.
Tel.: Redhill 3521. *Cable:* Fullion, Redhill.

William Gardner & Sons (Gloucester) Ltd.,
Bristol Road, Gloucester, England.
Tel.: Gloucester 21261. *Cable:* Gardner, Gloucester.

The Geigy Company Ltd.,
Rhodes, Middleton, Manchester, England.
Tel. : Middleton 3644. *Cable :* Geigy, Middleton.
Telex: 66–336.

The General Chemical & Pharmaceutical Co. Ltd.,
Judex Works, Sudbury, Wembley, Middx., England.
Tel.: Arnold 3883. *Cable :* Chemipharm, Wembley.

General Refractories Ltd.,
Genefax House, Tapton Park Road, Sheffield 10, Yorkshire, England.
Tel.: Sheffield 31113. *Cable:* Genefax, Sheffield.
Telex: 54–128.

Goka N.V. Machine Works,
Postbox 130, Koestraat 2a, Amsterdam C, Holland.
Tel.: 222255/6 *Cable:* Kagodam, Amsterdam.
Telex : 14173

Great Lakes Carbon Corp., *see* Dicalite Department.

E. Green & Son Ltd.,
Economiser Works, Wakefield, England.
Tel. : Wakefield 2706. *Cable :* Economiser, Wakefield.

Grill Floors Ltd.
West Row, North Kensington, London W.10., England.
Tel.: Ladbroke 3066/7 *Cable :* Etyladec, London.

Gruendler Crusher & Pulverizer Co.,
2915 North Market Street, St. Louis 6, Mo., U.S.A.
Tel. : Jefferson 1–1220. *Cable :* Grupulco, St. Louis.

Gutehoffnungshütte Sterkrade A.G.,
Werk Düsseldorf, Düsseldorf, Germany.

Haller & Phillips Ltd.,
14 Wool Exchange, Basinghall St., London E.C.2., England
Tel.: Monarch 9041. *Cable :* Haloid, London.

The Harland Engineering Co. Ltd.,
Harland House, 20 Park Street, London W.1.
Tel.: Grosvenor 1221/3. *Cable:* Rhoemetric, London.
Telex : 22881

G. M. Hay & Co. Ltd.,
Strathclyde Foundry, 42 Fore Street, Whiteinch, Glasgow, W.4, Scotland.
Tel. : Scotstoun 4390. *Cable :* Castiron, Glasgow.

Heath Filtration Ltd.,
Sneyd Mills, Newcastle Street, Burslem, Stoke-on-Trent, Staffs., England.
Tel.: Stoke-on-Trent 84698/87172.

G. H. Heath & Son (1952) Ltd.,
Heathcote and Greenhead Works, Burslem, Stoke-on-Trent, Staffs., England.
Tel.: Stoke-on-Trent 87273/4/5. *Cable:* Durability, Burslem.

Heemaf N.V.,
Postbox 4, Hengelo, Netherlands.
Tel.: 05400–5830 *Cable:* Heemaf, Hengelo.
Telex: 31307.

Heenan & Froude Ltd.,
Worcester, England.
Tel. : Worcester 23461. *Cable :* Heenan, Worcester.

Hein, Lehmann & Co. A.G.,
Abt. Massentrennung, P.O. Box 9107, Düsseldorf, Germany.
Tel.: 70201 *Cable :* Herrmannsieb, Düsseldorf.

Fr. Hesser Maschinenfabrik A.G.
Stuttgart-Bad Cannstatt, Nauheimerstr. 99, Germany.
Tel.: Stuttgart 53341. *Cable:* Hesser, Stuttgart-Bad Cannstatt. *Telex :* 072-2362

F. C. Hibberd & Co. Ltd.,
56 Victoria St., London S.W.1., England.
Tel.: Victoria 9517/8. *Cable :* Planetloco, London.

Hilger & Watts Ltd.,
98 St. Pancras Way, Camden Rd., London, N.W.1, England.
Tel. : Gulliver 5636. *Cable :* Sphericity, London.
Telex: 23852.

Samuel Hill Ltd.,
Lark Mill, Hare Street, Rochdale, Lancashire, England.
Tel. : Rochdale 2273. *Cable :* Filtering, Rochdale.

Hinz Elektromaschinen und Apparatebau,
(20b) Braunschweig, Frankfurter Str. 1a, Germany.
Tel. : Braunschweig 25533/4. *Cable :* Hinzmotoren, Braunschweig.
Telex : 0952753.

Holden & Brooke Ltd.,
Sirius Works, West Gorton, Manchester 12, Lancs., England.
Tel.: Ardwick 3883. *Cable:* Influx, Manchester.

Honolulu Iron Works Co.,
165 Broadway, New York 6, N.Y., U.S.A.
Cable : Honiron, New York.

Robert Hudson Ltd.,
Raletrux House, Meadow Lane, Leeds, England.
Tel. : Leeds 20004. *Cable :* Raletrux, Leeds.

Hudson & Wright Ltd.,
Halberton Street, Birmingham 18, England.
Tel.: Smethwick 0675/6. *Cable* : Desac, Birmingham.

Hudswell, Clarke & Co. Ltd.,
14 Howick Place, Victoria Street, London, S.W.1., England
Tel.: Victoria 6786. *Cable:* Hudclar, London.

Hunslet Engine Co. Ltd.,
125 Jack Lane, Leeds 10, Yorkshire, England.
Tel. : Leeds 32261. *Cable :* Engine, Leeds

IMACTI, Industrieele Maatschappij Activit N.V.,
Postbus 240c, Amsterdam, Holland.
Tel. : 60153. *Cable :* Activit, Amsterdam.

Isopad Ltd.,
Barnet By-Pass, Boreham Wood, Herts., England.
Tel.: Elstree 2817/9. *Cable:* Isopad, Boreham, Wood

A. Jobin & G. Yvon,
26 Rue Berthollet, Arcueil (Seine), France.
Tel.: Alésia 58–54.

Johns-Manville International Corp.,
22 East 40th Street, New York 16, N.Y., U.S.A.
Tel. : Lexington 2–7600. *Cable :* Johnmanvil, New York.

S. H. Johnson & Co. Ltd.,
Carpenters Road, Stratford, London, E.15, England.
Tel. : Maryland 7431. *Cable :* Filtrum, London.

Thomas C. Keay Ltd.,
P.O. Box 30, Baltic Street, Dundee, Scotland.
Tel.: Dundee 26031/4 *Cable :* Keay, Dundee.

Kek Ltd.,
Palmerston Street, Ancoats, Manchester 12, England.
Tel.: Ardwick 1104/5. *Cable* : Kekgrind, Manchester 12.

John King & Co. (Leeds) Ltd.,
Garnet Road, Leeds 11, Yorkshire, England.
Tel.: Leeds 75414. *Cable:* Malleable, Leeds.

Kingston Industrial Works Ltd.,
P.O. Box 72, Kingston 11, Jamaica, W.I.
Tel.: Kingston 86121 *Cable:* Industrial, Kingston.

Kirk & Co. (Tubes) Ltd.,
74/82 Paradise Street, London S.E.16, England.
Tel.: Bermondsey 3156/9. *Cable :* Kirflanges, London.

The Kleen-e-ze Brush Co. Ltd.,
Hanham, Bristol, England.
Tel. : Bristol 673027. *Cable :* Kleeneze, Bristol.

Köllmann & Gruhn,
Auf der Bleiche 9, Wuppertal-Oberbarmen, Germany.
Tel.: Wuppertal 598 808. *Cable :* Köllmannwerk, Wuppertal
Telex : 08512–774.

Krauss-Maffei-Imperial G.m.b.H. & Co.,
München-Obermenzing, Tannenweg 4, Germany.
Tel.: München 65 996. *Cable:* Imperial, München.
Telex: 052 3277.

Ets Krieg et Zivy,
9 Rue Louis-Lejeune, Montrouge (Seine), France.
Tel.: ALEsia 40–80. *Cable :* Krieg Zivy, Montrouge.

Krupp-Dolberg G.m.b.H.,
Essen, Ostfeldstr. 7, Germany.
Tel.: 21361 Essen. *Cable:* Kruppdolberg, Essen
Telex: 0857 732 kruppdolberg

Lafarge Aluminous Cement Co. Ltd.,
73 Brook Street, London, W.1, England.
Tel. : Mayfair 8546. *Cable :* Cimenfondu, London.

Lancashire Dynamo & Crypto Ltd.,
St. Stephen's House, Victoria Embankment, London, S.W.1.
Tel. : Whitehall 7211–5. *Cable :* Umformer, London.
Telex : 23880.

Lancashire Dynamo Electronic Products Ltd.,
see Lancashire Dynamo & Crypto Ltd.

Lepage, Urbain & Cie.,
105 Rue de la Convention, Paris 15e, France.
Tel. : Lecourbe 50–02. *Cable :* Alepage, Paris.

Librawerk,
Vossenkamp 1, Braunschweig, Germany.
Tel.: Sammel-Nr. 30851. *Cable:* Librawerk, Braunschweig.
Telex: 0952866.

Link-Belt Company, Department 1258–ISJL,
2680 Woolworth Building, New York 7, N.Y., U.S.A.
Tel. : Digby 9–4210. *Cable :* Linkbelt, New York.

N.V. Locospoor,
78 Bezuidenhout, The Hague, Holland.
Tel.: 720737. *Cable:* Locospoor, The Hague.

The Lunkenheimer Company,
Cincinnati 14, Ohio, U.S.A.
Cable : Lunken, Cincinnati.

LURGI Gesellschaft für Chemotechnik m.b.H.,
Frankfurt/Main, Lurgihaus, Leerbachstrasse 72/74,
Germany.
Tel.: 55–06–51. *Cable:* Lurgitechnik, Frankfurt.
Telex: 04–11108.

Lyddon & Co. Ltd.,
18/19 Savile Row, London, W.1, England.
Tel. : Regent 7321/9. *Cable :* Lyddexpor, London.
Telex : 2–2491

John McNeil & Co. Ltd.,
Colonial Iron Works, Helen St., Govan, Glasgow, S.W.1,
Scotland.
Tel. : Govan 1246. *Cable :* Colonial, Glasgow.

Marco Conveyor & Engineering Co. Ltd.,
Rowin Works, Lynn Road, Leytonstone, London, E.11,
England.
Tel. : Leytonstone 2254/5. *Cable :* Engimarco, London.

Markham Traction Ltd.,
Lincolnshire Ironworks, Stamford, Lincoln, England.
Tel. : Stamford 2226. *Cable :* Marktrac, Stamford.

Marshall, Sons & Co. Ltd.,
Gainsborough, Lincs., England.
Tel.: Gainsborough 2301. *Cable:* Marshalls, Gainsborough.

Martin's Cultivator Co. Ltd., *see* Markham Traction Ltd.

Mechans Ltd.,
Scotstoun Iron Works, Glasgow W.4, Scotland.
Tel.: Scotstoun 2211. *Cable:* Nautical, Glasgow.
Telex: 77234.

Metal Detection Ltd.,
Moseley Street, Birmingham 12, England.
Tel.: Victoria 0211. *Cable* : Metection, Birmingham.

The Mirrlees Watson Co. Ltd.,
45 Scotland Street, Glasgow, C.5, Scotland.
Tel. : South 2701. *Cable :* Mirrlees, Glasgow.

L. A. Mitchell Ltd.,
Harvester House, 37 Peter Street, Manchester 2, England.
Tel.: Blackfriars 7224/7824. *Cable*: Inspection, Manchester.

Mono Pumps Ltd.,
Mono House, Sekforde Street, Clerkenwell Green, London, E.C.1, England.
Tel.: Clerkenwell 8911. *Cable:* Monopumps, London.

Multi-Metal Wire Cloth Co. Inc.,
1341 Garrison Avenue, Bronx 59, N.Y., U.S.A.
Tel.: Kilpatric 2–2500. *Cable:* Multimetal, New York.

The New Conveyor Co. Ltd.,
Brook Street, Smethwick, Birmingham 40, England.
Tel.: Smethwick 2100. *Cable:* Aptitude, Birmingham.

Ateliers Neyret Beylier,
Boite Postale 48, Grenoble (Isère), France.
Tel.: Grenoble 44–73.80. *Cable:* Neyret, Grenoble

Niagara Filters Europe,
Alkmaar, Holland.
Tel.: 02200–6543/4 *Cable:* Niagara, Alkmaar.

N.V. Norit-Vereeniging Verkoop Centrale,
2de Weteringplantsoen 15, Amsterdam C, Holland.
Tel.: Amsterdam 39911. *Cable:* Noritcarbo, Amsterdam.

Etablissements A. Olier,
12 Avenue George–V, Paris, France.
Tel.: Elysées 27–30. *Cable:* Androlier, Paris

Orenstein & Koppel Ltd.,
31 Finsbury Square, London E.C.2., England.
Tel.: Monarch 4615. *Cable:* Orenkopp, London.

Parsons Chain Co. Ltd.,
Stourport-on-Severn, Worcestershire, England.
Tel.: Stourport 2551. *Cable:* Chainwork, Stourport-on-Severn.

The Paterson Engineering Co. Ltd.,
129 Kingsway, London, W.C.2, England.
Tel.: Holborn 8787. *Cable:* Cumulative, London.

Pennine Chainbelt Co. Ltd.,
Modder Place, Armley, Leeds 12, England.
Tel.: Leeds 63–8755. *Cable:* Pennine, Leeds.

Logan Perkins,
International Trade Mart., New Orleans, La., U.S.A.
Cable: Perco, New Orleans.

Permag Ltd.,
see Rapid Magnetic Machines Ltd.

The Permutit Co. Ltd.,
Permutit House, Gunnersbury Avenue, London, W.4, England.
Tel.: Chiswick 6431. *Cable:* Permutit, London.

P.G. Engineering Ltd.,
Parkfield Works, Stockton-on-Tees, Co. Durham, England.
Tel.: Stockton-on-Tees 67161.
Cable: Tetratomic, Stockton-on-Tees.
Telex: 58–530.

Pott, Cassels & Williamson Ltd.,
Motherwell, Scotland
Tel.: Motherwell 22. *Cable:* Pott, Motherwell.

Power Plant Co. Ltd.,
West Drayton, Middlesex, England.
Tel.: West Drayton 2626. *Cable:* Roc, West Drayton.

H. Putsch & Comp.,
Postfach, Frankfurter Str. 5–25, Hagen/Westfalen, Germany.
Tel.: Hagen 22341. *Cable:* Putsch, Hagenwestf.
Telex: 0823/795.

Railway Mine & Plantation Equipment Ltd.,
Imperial House, Dominion Street, London, E.C.2., England.
Tel.: Monarch 7000. *Cable:* Minplan, London.
Telex: 23787

Ransome & Marles Bearing Co. Ltd.,
Newark-on-Trent, Notts., England.
Tel.: Newark 456. *Cable:* Bearings, Newark.
Telex: 37–626

Ransomes Sims & Jefferies Ltd.,
Orwell Works, Ipswich, England.
Tel.: Ipswich 54711. *Cable:* Ransomes, Ipswich.
Telex: 1874.

Rapid Magnetic Ltd.,
Lombard Street, Birmingham 12, England.
Tel.: Victoria 1137. *Cable:* Magnetism, Birmingham.

Redler Conveyors Ltd.,
Dudbridge Works, Stroud, Glos., England.
Tel.: Stroud 1604/8. *Cable:* Redler, Stroud.

H. Reeve Angel & Co. Ltd.,
9 Bridewell Place, London, E.C.4, England.
Tel.: Fleet Street 9833. *Cable:* Papermen, London.
Telex: 22600, Stasaleco.

Machinefabriek Reineveld N.V.,
P.O. Box 22, Haagweg 127, Delft, Holland.
Tel.: Delft 24890. *Cable:* Reineveld, Delft.
Telex: 31027.

Richardson Scale Co. Ltd.,
Albert Street, Bulwell, Nottingham, England.
Tel.: Bulwell 27–1441/3. *Cable:* Richscalco, Nottingham.

Riedel-de Haën A.G.
Seelze/Hannover, Germany.
Tel.: Seelze 601. *Cable:* Riedelag Seelze.
Telex: 922748.

Rohm & Haas Company,
Washington Square, Philadelphia 5, Pa., U.S.A.
Tel.: Walnut 5–9860. *Cable:* Oropon, Philadelphia.

Rotameter Manufacturing Co. Ltd.,
330 Purley Way, Croydon, Surrey, England.
Tel.: Croydon 3816. *Cable:* Rotaflo, Croydon

Rotary Hoes Ltd.,
West Horndon, Essex, England.
Tel.: Herongate 361. *Cable:* Rotavator, Brentwood.

Sackfilling & Sewing Machine Syndicate Ltd.,
Timewell Works, Lockfield Avenue, Brimsdown, Enfield, Middlesex, England.
Tel.: Howard 1188. *Cable:* Fecit, Enfield.

Salzgitter Industriebau G.m.b.H.,
Salzgitter-Drütte, Braunschweig, Germany.
Tel.: Salzgitter-Immendorf 5411.
Cable: Hüttenbau, Braunschweig.
Telex: 0952837/38.

Salzgitter Maschinen Aktiengesellschaft,
Salzgitter-Bad, Western Germany.
Tel.: Salzgitter 3441. *Cable:* Samag, Salzgitter-Bad

Sandvik Steel Band Conveyors Ltd.,
Dawlish Road Works, Selly Oak, Birmingham 29, England.
Tel.: Selly Oak 1113/5. *Cable:* Simplicity, Birmingham.

SAPAL Société Anonyme des Plieuses Automatiques,
54 Avenue Dapples, Lausanne, Switzerland.
Tel.: Lausanne 26.10.95. *Cable :* Autoplieuse, Lausanne.

Saunders Valve Co. Ltd.,
Cwmbran, Newport, Monmouthshire, England.
Tel. : Cwmbran 3081. *Cable :* Saunval, Newport, Mon.

Carl Schleicher & Schüll,
Dassel, Kr. Einbeck, Germany.
Tel. : Dassel 395. *Cable :* Selecta, Dassel.

Schmidt & Haensch,
Schöneberg, Berlin-West, Germany.
Tel.: 71 16 25. *Cable:* Polarisation, Berlin.

Schumacher'sche Fabrik.
Bietigheim/W., Germany.
Tel.: 655–659. *Cable :* Bismolith, Bietigheim
Telex : 724217.

N.V. Servo-Balans,
Wegastraat 40, Den Haag, Holland.
Tel. : Den Haag 723874. *Cable :* Servobalans, Den Haag.

SIG Swiss Industrial Company,
Neuhausen Rhine Falls, Switzerland.
Tel.: Neuhausen Rhinefalls 5 77 31.
Cable: Sig, Neuhausenamrheinfall
Telex : 5 27 23

Henry Simon Ltd.,
Cheadle Heath, Stockport, Cheshire, England.
Tel.: Gatley 3621. *Cable :* Reform, Manchester
Telex : 66–287.

Richard Simon & Sons Ltd.,
Phoenix Works, Basford, Nottingham, England.
Tel. : Nottingham 75136. *Cable :* Balance, Nottingham.

The Skefco Ball Bearing Co. Ltd.,
Luton, Beds., England.
Tel.: Luton 5700. *Cable :* Skefco, Luton.
Telex : 82120

S.K.H. & Son (Salopian–Kenneth Hudson & Son),
Prees, Whitchurch, Shropshire, England.
Tel. : Prees 331–5. *Cable:* Implements, Prees.

A. & W. Smith & Co. Ltd.,
21 Mincing Lane, London, E.C.3, England.
Tel. · Mansion House 4294. *Cable :* Sugrengine, London.
Telex : 2–2404

Sparkler International Ltd., European Branch,
Leliegracht 9, Amsterdam, Holland.
Tel.: Amsterdam 43077/44158. *Cable:* Spafileur, Amsterdam.

S.P.E.I. Chim.,
Boîte Postale 85–08, Paris (8e), France.
Tel. : Anjou 02–84 *Cable :* Rectifpast, Paris.

Spencer (Melksham) Ltd.,
Melksham, Wilts., England.
Tel.: Melksham 2251/3. *Cable:* Spencer, Melksham.

Spoorijzer N.V. Delft.,
Postbox 10, Delft, Holland.
Tel. : 25931. *Cable :* Spoorijzer, Delft.
Telex : 31031

The Squier Corporation,
490 Broadway, Buffalo 4, N.Y., U.S.A.
Tel.: Cleveland 4567. *Cable :* Squier, Buffalo.

Standard Steel Corporation,
5073 Boyle Avenue, Los Angeles 58, California, U.S.A.
Tel. : LU 5–1234. *Cable :* Stansteel, Los Angeles.

John G. Stein & Co. Ltd.,
Bonnybridge, Stirlingshire, Scotland.
Tel : Banknock 255/8. *Cable :* Stein, Bonnybridge.
Telex : 77–506.

Stephens-Adamson Mfg. Co.,
Ridgeway Avenue, Aurora, Illinois, U.S.A.
Cable : Saco, Aurora, Ill.

Duncan Stewart & Co. Ltd.,
Park Gate, Glasgow, C.3, Scotland.
Tel: Douglas 1371–4. *Cable :* Stewart, Glasgow.

Stordy Engineering Ltd.,
Cumbria House, Goldthorn Hill, Wolverhampton, England.
Tel.: Wolverhampton 37341/2.
Cable : Thermal, Wolverhampton

Stork-Werkspoor N.V. (V.M.F.),
Amsterdam (C), Holland.
Tel.: Amsterdam 744111. *Cable:* Werkspoor, Amsterdam.
Telex: 11102.

Strachan & Henshaw Ltd.,
Steelhoist Works, St. Philips, Bristol 2, England.
Tel. : Bristol 78331. *Cable :* Stelhoist, Bristol.
Telex : 44170.

Suchar Sales Corporation,
76 Beaver Street, New York 5, N.Y., U.S.A
Tel. : Whitehall 4–0280. *Cable :* Sucharing, New York

Sugar Manufacturers' Supply Co. Ltd.,
7–8 Idol Lane, London, E.C.3, England.
Tel. : Mansion House 4710. *Cable :* Sumasuco, London.

Richard Sutcliffe Ltd.,
Horbury, Wakefield, Yorkshire, England.
Tel.: Horbury 350. *Cable:* Sutcliffe, Horbury.

A.B. Svenska Flaktfabriken,
Kungsgatan 18, Stockholm 7, Sweden.
Tel. : Stockholm 23 82 20. *Cable :* Flaktfabriken.
Telex : 1340 Flakt.

Talbot Stead Tube Co. Ltd.,
Green Lane, Walsall, Staffs., England.
Tel.: Walsall 4186. *Cable:* Talbot, Walsall.
Telex: 33387.

Taylor Controls Ltd.,
75 Hale End Road, Walthamstow, London, E.17, England.
Tel.: Larkswood 3371–6. *Cable:* Taylortrol, London.

Technoexport Czechoslovakia,
56 Vaclavske nam., Prague 2, Czechoslovakia.
Cable: Technoexport, Prague.

John Thompson Ltd.,
Ettingshall, Wolverhampton, England.
Tel.: Bilston 41121. *Cable :* Boiler, Wolverhampton.

John Thompson Conveyor Co.
see John Thompson Ltd.

John Thompson (Dudley) Ltd.,
see John Thompson Ltd.

John Thompson Instrument Co. Ltd.,
see John Thompson Ltd.

John Thompson-Kennicott Ltd.,
see John Thompson Ltd.

John Thompson Ordnance Co.,
see John Thompson Ltd.

John Thompson Water Tube Boilers Ltd.,
see John Thompson Ltd.

Walter Thron GmbH,
Hildesheim, Römerring 15–16, Germany.
Tel.: Hildesheim 83318/83319. *Cable :* Wetcha, Hildesheim.
Telex : 09–2718

Tiss-Metal,
55 Rue la Boétie, Paris 8e, France.
Tel.: Ely 41–80. *Cable :* Tissmétal, Paris.

Unifloc Ltd.,
11/16 Adelaide St., Swansea, Glamorgan, Wales.
Tel.: Swansea 55164 *Cable:* Unifloc, Swansea.

United Norit Sales Corporation Ltd.,
see N.V. Norit-Vereeniging Verkoop Centrale.

U.S. Industries Inc. (Great Britain) Ltd.,
New Bond Street House, 1–5 New Bond St., London W.1., England.
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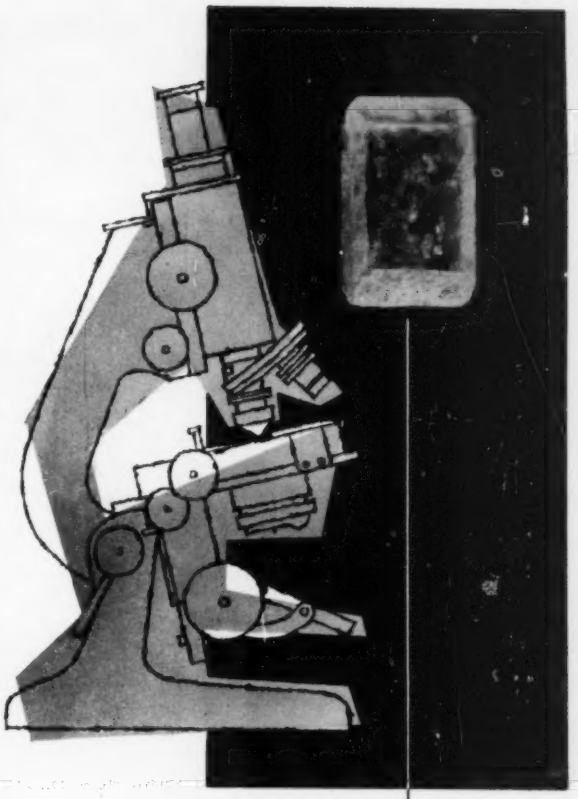

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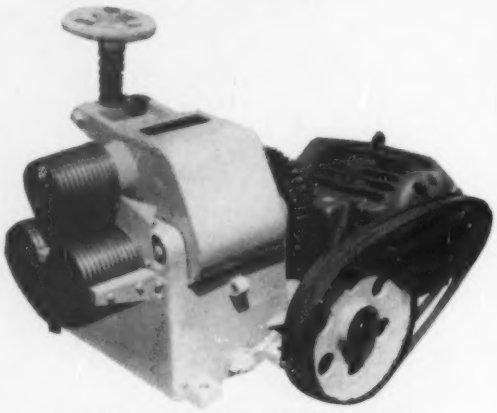

The illustration shows a ROLEX mill belt-driven by a 3 h.p. electric motor

The **ROLEX** laboratory three-roller cane mill has recently been improved. The 5" x 5" rolls are now in Meehanite cast iron and the spur gears and the casting carrying the adjustable top roll are of steel. Otherwise the general layout is as formerly. A compression spring is provided for the adjustable top roll, oilite bearings fitted, and a 20:1 gear ratio. Scrapers are also fitted to both bottom rolls. The juice tray and scrapers are removable for general cleaning.

For further information, see page 26 of the Suma catalogue, which will be sent on request.

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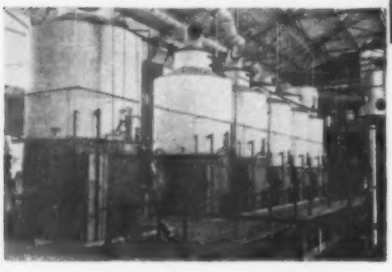

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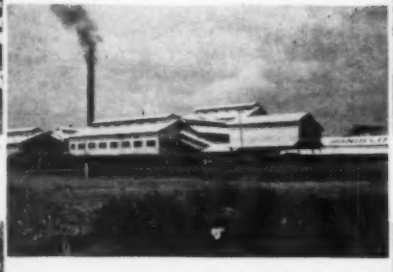

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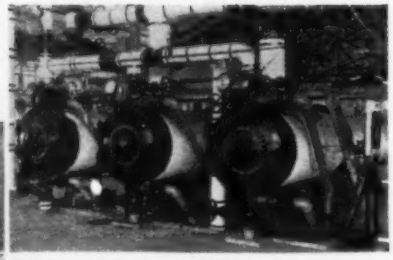

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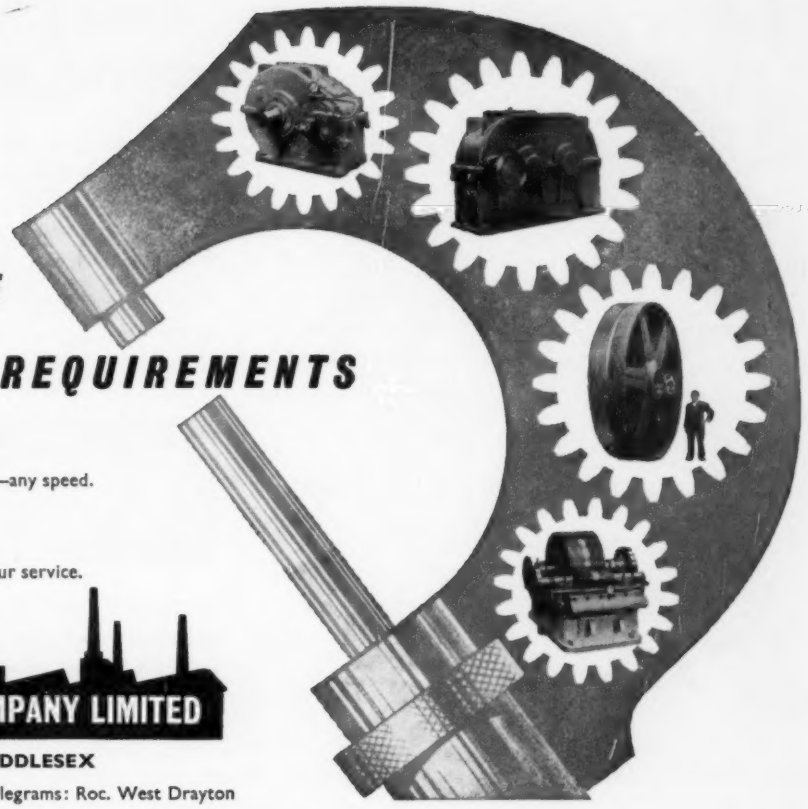

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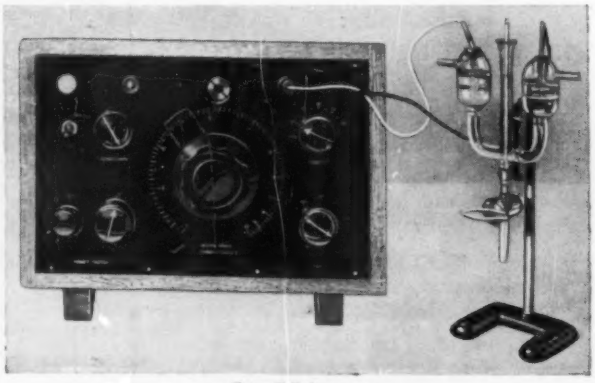

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1959 has been a paradoxical year. With the public press reporting good business for the country as a whole, it has taken a discerning student to discover that the part of the economy relating to capital goods has only bettered to a modest degree. This fact, plus the low carryover of orders from 1958, caused us to have an unhappy year financially.

However, with the modest but positive increase in business in the U.S.A. and the substantial increase in orders for most of our overseas areas, we look forward with confidence to 1960. Improvement of efficiencies in all internal departments has also been positive and is continuing both as to costs and the time it takes to do things. This naturally will be beneficial to our customers.

SUGAR — Orders from new and expanding cane sugar factories in India for RapiDorr Clarifiers and Oliver-Campbell Filters contributed significantly to the business of our subsidiary in that country. And in other locations around the world—Mexico, British Honduras, Egypt, Mozambique and Swaziland, for example — these two units continued to be accepted as standard in the industry. In beet sugar, a British producer purchased First Carbonation Thickeners and Vacuum Filters for two new mills; and two Italian mills will use a total of four Vacuum Filters.

PETROLEUM—A variation of the initial application of the DorrClone Desanding System in fresh water treatment is the desanding of salt water used to recharge wells for secondary oil recovery at a West Coast location. Outside the U.S. our Japanese representative is fabricating filters for use in a catalytic cracking process and our British company will supply oil-water separators for both British and Brazilian refineries. Also of interest is equipment for a pilot plant to recover oil from tar sands.

PROJECT ENGINEERING — This phase of our operations was also particularly active in 1959 as design of phosphoric acid plants to be located in Idaho, Great Britain and Ireland and a phosphoric acid and triple superphosphate installation for Brazil was commenced. Also in the fertilizer field was a contract for process modification of a large British plant.

Late in the year, work was started on design of a large limestone crushing plant for which D-O will also purchase equipment and other materials. Our French subsidiary and domestic company working jointly virtually completed design of a large Yugoslavian copper concentrator. Two smaller but nonetheless significant projects—both including laboratory testing and feasibility studies — involved production of a limestone substitute to be used for self-fluxing sinter in blast furnace operation and the recovery of nickel from waste pickle liquors.

FLUOSOLIDS SYSTEMS — One of the new applications of the FluoSolids system this year has been preheating coarse shale in a special three-compartment reactor to produce light-weight aggregate. A second is drying iron ore before magnetic separation and concentration. Currently, the iron ore industry appears to have other drying applications ideally suited to fluidization. FluoSolids roasters are also under construction for a Canadian smelter where only partial sulfur removal is required.

Projects involving already proven applications have included in 1959 a pyrite roaster for a sulfuric acid plant on Formosa, three systems marketed by our Italian subsidiary for roasting pyrite to produce sulfur dioxide for pulp mill bisulfite cooking liquor and for a large zinc roasting installation in Yugoslavia, a large coal dryer for a Western producer, a copper-cobalt roaster in the Belgian Congo and detergent dryers in the United States.

METALLURGICAL — As in past years our work in this area has involved virtually all of the metallic minerals from gold to iron ore. The latter field as been among the most active with purchase of Sizers and Filters for Canadian washing plants, DorrClone classifiers for desliming prior to flotation, and Thickeners, Filters and Pumps for recovery of blast furnace flue dust.

PULP AND PAPER—A new tool for this industry is a novel pressure washing filter. Installation of the first U.S. manufactured unit is being made in a Southeastern pulp mill. Ideally suited to brownstock washing, the unit has a number of advantages from both the operating and installation standpoints.

Recausticizing systems including process flowsheet innovations, such as precoat operation of the Lime Mud Filter and application of a two-compartment White Liquor Clarifier with special feedwell, were purchased for new or expanding mills in Canada, India, the United States, Portugal, Japan, Yugoslavia, Scandinavia and the Philippines.

Around the world the American Saveall continued to be recognized as the major means of recovering paper machine fibers from white water and in the U.S. the largest bleach tower designed to date will soon go into operation. An unusual and interesting application of the Merco Centrifuge is recovery of by-product material used as a drill mud dispersant at a West Coast mill.

CHEMICAL — During the year applications of the Plastic Filter, first introduced in mid-'58, were broadened to include a variety of fine chemical and pharmaceutical separations and washing of acid leach liquors from metallurgical pulps. Also in the realm of new applications is dewatering of various plastics using the Mercone Screening Centrifuge.

As usual, our standard line of equipment played a major role in a great number of Italian chemical plant expansions and in large new or expanded facilities in France, Germany, Spain, Mexico and here at home.

FOOD PRODUCTS — Successful application in 1958 of the Mercone-Precoat Filter combination for apple juice processing has resulted in orders from two West Coast packers for similar stations.

In starch, several domestic and overseas producers will employ D-O Centrifugals of virtually every design for current modernization and process modification projects. Our Dutch subsidiary has put into operation three corn and potato starch washing and processing plants in Germany and Finland.

We have noticed with much concern the apparent growing tendency of many users of services and equipment to buy almost exclusively on price rather than on demonstrated product quality and the essential engineering services made available to them during planning and after installation. This is not a new subject — and one on which there has been much forceful editorial comment in the technical press.

This practice confronts the supplier with the practical short range choice of sacrificing product quality and needed engineering, losing the business, or taking it at a loss. For our own part, we do not propose to fall into this trap which, economic considerations aside, can only result in arresting technological advance and which could have a profound effect on the leadership of the free world in things technical.

J. D. Hitch, Jr.
Chairman of the Board

December 1, 1959

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